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ONR Final Report
A Configurable Task Environment For Learning Research

Version 2.7

Douglas M. Towne

Behavioral Technology Laboratories
University of Southern California

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This report describes the final version of a software system designed to support learning researchers and others in creating and delivering real-time interactive scenarios in tactical decision making. The system, known as CIC, permits developers to readily produce custom scenarios involving simulated aircraft and ships, both friendly and hostile, and to collect performance data from experimental participants. Situational variables which can be manipulated include atmospheric conditions, equipment operability, lengths of time delays, as well as aircraft and ship positions, speeds, and headings.

The system includes the capability to generate scenarios automatically, within specified situational variables; to communicate automatically with an artificial decision making process; and to provide part-task exercises in aspects of radar system operation and control.

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Background & Acknowledgments

This application was developed under funding from the Office of Naval Research. The original work was performed under contract N00014-93-1-1150, Susan Chipman, Sponsor Program Manager. Subsequent versions (2.6 and 2.7) and technical support were provided under contract N00014-95-1-0782, Helen Gigley, Sponsor Program Manager. The simulation development system used, RIDES, was developed at Behavioral Technology Laboratories under Air Force funding at Armstrong Laboratories, James Fleming Program Manager. RIDES, in turn, is a descendent of an earlier system, the Intelligent Maintenance Training System (IMTS), developed under funding from ONR.

This document supersedes previous reports, *ONR Final Report* dated August 1995, and *A Configurable Task Environment for Learning Research*, dated March, 1996.

Summary

This software provides a moderately realistic simulation of a shipboard radar tracking system, such as AEGIS. The graphics resemble those provided on the large–screen display of the AEGIS system, and the commands which can be issued are many of those available to the decision–maker commanding a CIC team. The simulated radar display of air and sea tracks are updated on a real–time basis, and the display reflects movements of these craft in real time. Depending upon the scenario conditions specified, the air and sea craft may be friendly or hostile, and they may or may not react to actions taken by the CIC team. A wide range of atmospheric and system readiness conditions can be established for any individual exercise. In addition, the various craft may be set up to execute maneuvers of their own, i.e., not in response to actions taken by the CIC personnel. The individual targets may be configured to represent virtually any type of craft, ranging from commercial fishing vessels, private helicopters, or commercial airliners to high–performance military aircraft.

A unique feature of this software is its ability to be easily configured by a non–programmer to simulate a wide range of conditions and tactical scenarios. An experimenter can define any number of initial conditions as well as within–problem actions taken by the various ships and aircraft. If desired, the system can be directed to generate problem conditions automatically, so that human participants or computer–based decision models can experience hundreds or thousands of problems with very little configuration effort on the part of the experimenter. The system also supports research in machine learning, as it can accept decisions of an external software system as if those decisions were made by a human user.

Finally, the system provides features that can be exploited for training. One such feature allows expert tacticians to perform recommended responses to specific tactical situations and to distribute these completed presentations to classrooms or to the fleet via floppy diskette. Learners or instructors can then replay those scenarios at remote locations to observe the expert performance, and to attempt to emulate them. The ability to pause and resume, as well as control the speed of the simulation further enables learners and instructors to examine conditions and consider alternatives in ways the true real–time environment tends to discourage.

Hardware and Operating System Requirements

The CIC simulation may be run on two platforms:

1. PC 486 with at least 16 MB RAM (20 or 32 MB is better) running SCO Unix or Linux, Version 1.2.x or later.

2. Sun SPARCstation

The screen resolution should be set to 1024 x 768.

Downloading Software

The CIC system is summarized on the CIC Web page:
http://www.fcs.net/dtowne/default.htm

To download the CIC software, go to http://www.fcs.net/dtowne/dnload, click on Cicv2x7.z, download the file, and then unCompress it.

CIC is a RIDES application. **Users should install RIDES version 4.2.7 or later**. To download this, go to the CIC Web page, go to the Download files section, click on "The RIDES run-time simulation engine (sRIDES)", select the desired platform, download the file, and then gunzip it.

Distribution Files and Installation

Files

The files may be distributed via floppy diskettes or via the Internet. Some of the files will be distributed compressed (with a .Z suffix), and must be uncompressed prior to use. If the files are accessed from the Internet, some of the file names will differ slightly. In this case, those names in **bold** ***must be named as shown below*** (the platform-specific files may be renamed *rides* or RIDES if desired.)

Platform–specific simulation engine:

sridessn.z	for use on a Sun SPARCstation (2 diskettes)
sridespc.z	for use on an IBM compatible PC (2 diskettes)

Platform–independent files: (1 diskette)

cicvaxb	(the CIC application; a and b reflect the latest version number)
CICDescriptions	(editable descriptions of various aircraft and ships)
SessionPlan	(an example instructional plan presented in a session)
config1, config2, ..	(some predefined example configurations)
portNames	(an example list of airport names)
rides_defaults	(specifications required by the RIDES system)
testml	(test program used to verify machine learning communications)

CICDescriptions, SessionPlan, and portNames are fully editable by the end user using a text editor. The config files (see Appendix D) are modifiable using the CIC configuration authoring features.

Installation Steps

1. Copy the file sridespc.z or sridessn to your home directory, as follows:
   a. Put diskette #1 into the floppy drive.
   b. Enter **tar xvfm /dev/fd0**
   c. If the system does not prompt you to insert floppy disk #2, you must rename the file; use a name like temp1. Then repeat step b for floppy #2, renaming the file temp2. Finally, concatenate the temp files with **cat temp1 temp2 > temp.Z**

2. Uncompress the .z file, and rename it RIDES or rides.

3. Copy the files from the CIC diskette to the same directory, as in step 1. The files may then be moved to another directory, except for rides_defaults which should remain in the home directory. If necessary, rename the files marked above.

4. The simulation functions more smoothly if you place this line in the file .Xdefaults, found in your home directory: **Mwm*resizeBorderWidth: 6**

Check to see if there is already a resizeBorderWidth line in the file; if so, make sure the integer given is 6. Otherwise, add this line to the file, exactly as shown (use tab or blanks between the colon and the 6).

System Startup

To start the simulation, change to the directory containing the CIC files, then enter the statement

```
sRides  -s  CICV2.7
```

which assumes that the RIDES file is named sRides and that the CIC file is named CICV2.7 (spaces between arguments have been enlarged for clarity).

(Sun users only: Some older Sun workstations have a bug in X. Try using *openwin* to start X on the Sun, rather than using *startx*.)

Wait about 30 seconds, until the mouse icon changes from a watch to a hand. You will now see a start–up screen with a User Name field. The name entered here determines in which of three possible modes the simulation is run:

1. data collection mode

To identify a human participant in a learning experiment, key in any identification name that is also a legal file name in your system (click on the field, key in the name, press the Return key). The name may be the participant's name, or it could be an alphanumeric code. Then click on the **Proceed** button. Thereafter, the keyboard is not used unless the user has been given access to certain special options. The screen will then display the simulated radar presentation, various buttons used to operate the simulated system, and a prompt to click on **Begin** to start the first problem. To begin a problem, click on **Begin**. The system will then present problems in the order specified in the file **SessionPlan**, described below.

At the end of each problem, a message will be displayed advising the user that the problem has ended, and to click on **Begin** to start the next problem. Optionally, a performance score will be displayed, and the user may be allowed to examine the true identities and intentions

of all the craft involved in the just–completed exercise. At the end of the final exercise, the user is advised that the session is complete.

2. authoring mode
To author new tactical exercises (configurations) or modify existing scenarios, key in the term *author* to the name ID field (click on the field, key in *author*, press the Return key). Then click on the **Proceed** button. As author, you may define and save scenario configurations and environmental conditions, retrieve and modify previously defined configurations, and run problems. The file SessionPlan, described below, does *not* control the session in authoring mode, and it is not referenced by the system. Author actions in working trial problems are written to the single file named *author*. This file contains data just for the previous problem worked. Refer to the section entitled Authoring Mode for further authoring details.

3. machine learning mode
To run problems to be worked by a machine learning model, key in *machine* to the name ID field (click on the field, key in *machine*, press the Return key) then click on **Proceed**. Now, the system will automatically run the problems specified in the SessionPlan file, described below.

Quitting the Simulation

To exit the simulation normally, click on the **Quit** button displayed in the upper left hand corner of the screen. To abort a run under unexpected conditions, bring the Term window to the front and press the Delete key.

The three mode types are now detailed in the following main sections.

Data Collection Mode

If any name other than *author* or *machine* is entered as the user identification, the simulation runs in a data collection mode. In this mode, the system presents problems according to the specifications in the SessionPlan file, and it writes out performance data to files named <username>.x where username is the user's identification, and x is an integer signifying the problem number, e.g., *smith.1, smith.2, smith.3.* The format of the SessionPlan file is provided in the Authoring section. The contents of the user's performance data file is provided in a subsequent section (Task Performance Data).

The Simulation

In data collection sessions, the simulation screen appears as shown in Figure 1. The major components on this screen are these:

Utility buttons, to Begin and Pause problems.

The *radar display* representing the radar screen, showing various targets and, depending upon the radar range selected, portions of the surrounding land mass.

Display controls, used to show or hide various elements of the radar graphics.

Range controls, used to set the range of the simulated radar system.

The *Character Read Out* box, which displays information about the selected target.

Threat Assessment buttons (Friendly, Hostile, Unknown), used to classify the selected target according to its believed threat.

User action buttons, used to issue orders to other virtual crew members, or inquiries and warnings to aircraft and ships.

Elapsed time and Local time indicators which display the elapsed time on the current exercise, and the simulated time of day on a 24–hour clock. Experimental participants should be advised that the simulated time of day may be quite different than the true time of day at their location, thus visual identifications may be affected by the available sunlight.

User Prompt Box, which provides directions to the user, such as "Click on Begin to start your first problem." This box is also used to prompt the author during authoring.

Verbal communication display, the rectangle below the radar display, in which all verbal communications are displayed. This box displays the verbal commands that go out as a result of selecting a user action button, as well as any responses from the crew or from contacted ships or aircraft.

Problem number, a number that increases from 1 to the number of problems taken.

Also shown at the end of each problem, if requested by the experimenter, a *performance score* and a *target debriefing box.* The target debriefing box appears over the verbal communication box, and displays the characteristics of any selected target.

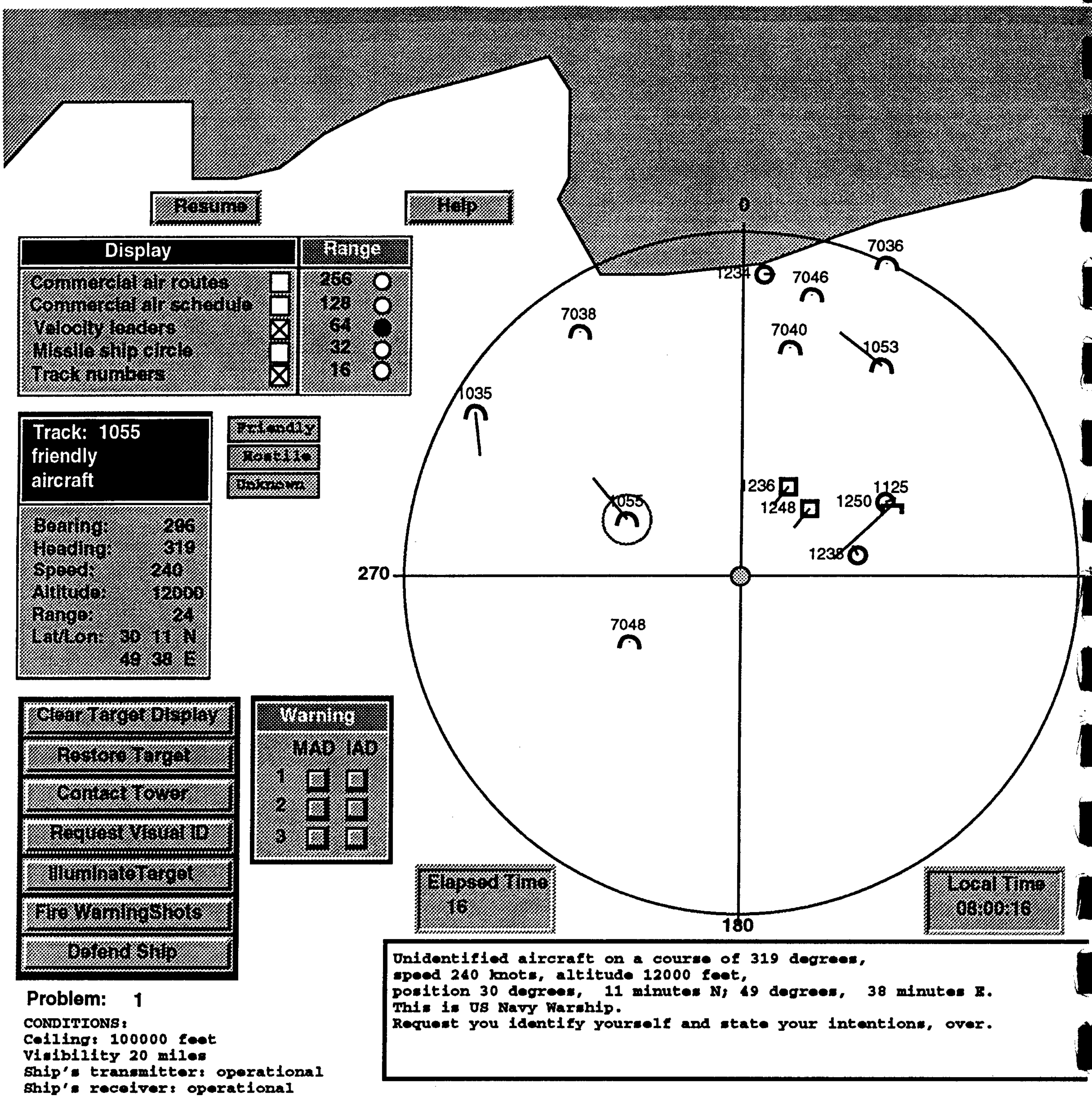


Figure 1. The CIC Simulation Screen.

User Actions

All user actions are made via the left mouse button, as follows:

Begin. The user clicks on this button to begin a problem. In response, the system sets up the next exercise and starts the clock.

Pause. If visible, this button is used to temporarily pause a problem (stop the clock). If a problem is paused, this button's label changes to *Resume*. In pause mode, the user may select targets, view their characteristics in the Character Read Out box (see below), change the displayed radar range, or change any of the Display options. The system can be set up so that users cannot pause, in which case this button is not visible.

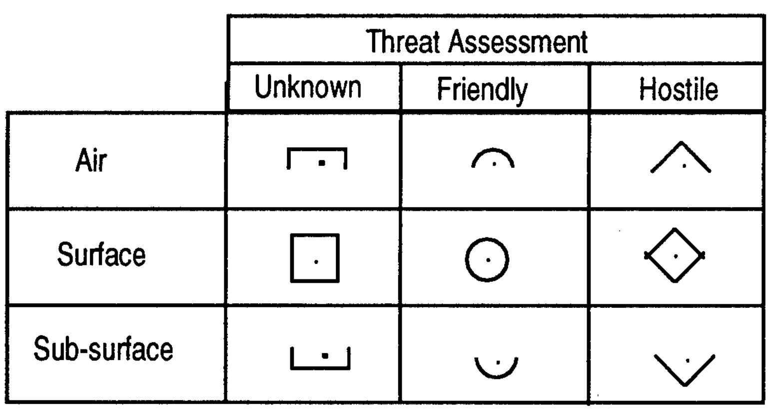
Display. Clicking on any of the five check boxes toggles the visibility of the listed display element. The five boxes are independent of one another. At the start of each problem, the Display buttons are initialized as follows:

Commercial air routes	unchecked	(not visible)
Commercial air schedules	unchecked	(not visible)
Velocity leaders	checked	(visible)
Missile ship circle	unchecked	(not visible)
Track numbers	checked	(visible)

Range. Clicking on any of the five radio buttons sets the outer circle of the radar display to the range selected, in miles.

Target Selections. The user selects a particular target displayed in the radar area by clicking on it. In response to this an audible beep sounds, a red circle is displayed around the selected target, and the target's characteristics are displayed in the table displayed to the left of the radar display. This box, called the Character Read Out (CRO) provides information about the target such as its track number, bearing, heading, speed, etc. The values in this table change over time as the selected target moves.

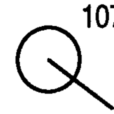
Each target sensed by the (simulated) radar is displayed according to its type (aircraft, surface vessel, submarine), and its threat assessment (friendly, hostile, unknown). Thus there are 9 possible symbols for targets, as follows:



The threat assessment of a target is initially established in a problem's configuration; this represents the initial determination that has been assigned each target by the CIC crew using the AEGIS system. These initial designations may be correct (all friendly and hostile designations are correct), vague (many unknown designations), or incorrect (one or more

targets incorrectly designated as friendly or hostile). The threat designation of any target may be changed thereafter by the user to maintain a visual cue of his or her beliefs.

In addition, a target has a *track number* designation, a 4–digit number assigned to the target for that exercise, and a *velocity leader*, a line whose direction indicates the current heading of the target and whose length designates the current speed of the target. As with the actual AEGIS system, the relation between the length of the velocity leader and the target's speed is nonlinear, so that small velocities can be seen, and large velocities do not overwhelm the display. The track number and velocity leader can be made visible or invisible by the user. The following display is a friendly ship, designated as track number 1073, traveling in a south-easterly direction.



The simulation comes stocked with four kinds of targets (see Appendix A):
1. aircraft
2. surface vessels
3. subsurface vessels
4. clutter (distracting radar images that appear to be real)
   (Clutter targets appear as friendly air targets, with 0 speed and 0 altitude)

A particular exercise may involve any subset of the available targets, each target configured per the requirements of the experimenter.

All user actions listed below pertain to the *selected* target. All user actions that are orders to other crew members will produce textual orders in the verbal communication box, after some delay. After an additional delay, some of the commands may produce responses from contacted targets or land–based towers. See appendix B for the built–in delays that pertain to the user actions.

<u>Friendly, Unknown, Hostile</u>. The user clicks on these buttons to designate the threat of the currently hooked target as being friendly, unknown, or hostile. In response, the system changes the graphic symbol representing the selected target to correspond to the current threat assessment.

<u>Clear Target Display.</u> The user clicks on this button to make the selected target disappear. This can be done to eliminate distracting clutter targets.

<u>Restore Target</u>. The user clicks on this button to make previously cleared targets reappear. Each click of this button restores the display of a previously–cleared target, working from the most recently cleared to the first cleared target, for that problem.

<u>Contact Tower</u>. The user clicks on this button to get in touch with a land–based control tower to determine if the hooked target might be a commercial airliner. The particular tower contacted is not explicitly identified; it is assumed that the appropriate tower is contacted. When the **Contact Tower** button is pressed, a verbal inquiry is sent to determine if the hooked target might be a commercial airliner, under control of the tower. If there is a commercial air liner in the vicinity of the hooked target (position within 5 miles of the hooked target and altitude within 5,000 of hooked target), a response will be received to that effect, after some delay.

Otherwise, the tower will respond that there is not a commercial airliner in the vicinity indicated by the hooked target. Thus, if there are two or more aircraft flying in a close group, one of which is a commercial airliner, the tower will confirm presence of an airliner in the area of the hooked target, even if the hooked target does not happen to be the airliner itself.

Request Visual ID. The user clicks on this to command the bridge to attempt to make a visual identification of the selected target. The bridge will respond with an identification, after some delay, if the following conditions are all true:
The local time is between 6 A.M. and 6 P.M. (i.e., it is daylight).
The target's altitude is less than the ceiling for the problem.
The target's range is less than 50 miles and less than the visibility for the problem.

Illuminate Target. The user clicks on this to 'illuminate' the selected target. This action alerts the selected target that it is being acquired for defensive action, and also serves as a drastic warning to a target that is not responding to radio warnings. After some delay, an illuminated target will turn away from the ship if 1) it is configured as one which will heed warnings, 2) it is within 30 miles range, and 3) it is an aircraft whose IFF mode is 1,2, or 4.

Fire Warning Shots. The user clicks on this to fire warning shots at the selected target. The target will turn away from the ship if 1) the target is configured as one which will heed warnings, and 2) the target range is less than 5 miles.

Defend Ship. The user clicks on this to command the crew to take defensive action against the selected target. There is not a simulation of the weapons hitting or missing the target, but if the target is within the missile ship circle (12 miles) it will disappear from the screen[1].

Warning. The user clicks on any of these six buttons to issue a radio warning to the selected target. Warnings are at three possible levels, and may be issued on two possible radio bands: (1) Military Air Distress (MAD), and (2) International Air Distress (IAD).

The selected target will *receive* the warning if the following are all true:
o the ship's transmitter is operational (if limited range, target must be within 10 miles);
o the target is monitoring the band upon which the warning was sent (MAD or IAD);
o the target's receiver is operational.

The target will turn away from the ship, after some delay, if: 1) the target receives the warning, 2) the warning is issued at level 2 or 3, and 3) the target is configured as one which heeds warnings. The target's verbal response to the warning *will be displayed* in the verbal communication box if: 1) the target receives the warning, 2) the target's transmitter is operational, and 3) the ship's receiver is operational. If desired, the experimenter may set the target's verbal response to be silence by creating a line in CICDescriptions that contains " ", and setting the target's selfID to that line number.

Pop-up Targets

Aircraft below 200 feet altitude are not displayed. This adds realism to the exercises, and it provides the author the capability to produce targets that 'pop-up' during an exercise, i.e., they are not seen until they rise above 200 feet.

[1] This feature was introduced in Version 2.6.

Task Performance Data

The details of each exercise run in data collection mode are written chronologically to an ASCII format data file. The file created for the first exercise run by user Smith is named Smith.1, the second is Smith.2, etc. To minimize the data loss if a power outage or other failure should occur, each exercise is written to a separate data file. The data file contains:

- problem specs — user ID, problem number, time and date of problem presentation, scenario name, environmental conditions, list of active target types, file write interval, and number of active targets and clutter targets.
- periodic updates — the positions, speeds, etc. of each target at each update time;
- user actions — overt actions made by the user;
- replies — radio messages received from targets, towers, and other crew members;
- end marker — a record coded 99, followed by
  a. seconds since start of problem;
  b. the user's performance score;
  c. eleven measures of performance, corresponding to the weights W2 through W12 detailed in the section entitled *Scoring the User's Performance.*

Problem Specs

Each exercise file is headed with sufficient information to completely replay the problem (given that the scenario file originally used is still available). This header information provides the following:

1. title:	The name of this data file
2. date and time of file creation	(time may be in error on some installations)
3. scenario name	Name of scenario configuration file
4. environment data (16 characters, total)	
ceilingButtons (3):	001,005,010,025, or 100 (thousand feet)
visibilityButtons (3):	01,05,10,20,30 (miles)
recvrButtons (2):	0,1,2,3 (failed, OK, intermittent, limited range)
xmtrButtons (2):	0,1,2,3 (failed, OK, intermittent, limited range)
local time (6):	like "18:30"
5. file write interval, in seconds	
6. number of active targets (2 chars), number of active clutter targets (2 chars).	

Problem Data

Problem data are written to the file as the problem progresses. Data are of three types:
(1) periodic updates which reflect the status of each target at a particular time;
(2) user actions, written whenever the user makes an overt action, and
(3) replies, written whenever a reply is received to some command or inquiry.

Each record starts with a 2-digit code as listed in the table below. Following each code is the time at which the action took place, in seconds, after start of problem. For all record types except periodic update, this is followed with the track number of the target involved.

code	activity
01	periodic target update
02	hook (select) a target
03	warn the hooked target
04	the warned target replies
05	fire warning shots near the hooked target
06	illuminate the hooked target
07	request visual ID of the hooked target
08	receive visual ID of hooked target from bridge
09	contact the tower regarding the hooked target
10	receive information from tower regarding hooked target
11	change threat assessment of hooked target
12	open
13	open
14	clear hooked target display from screen
15	restore last cleared target
16 - 29	--- open ---
30	change display (comm'l air routes, ..., radar range)
31–49	--- open ---
50	a hostile target fires at own–ship
60	own–ship fires at hooked target
99	end of problem, plus user's performance score

Codes for Performance Data Files

For example, a record `05 0083 1244` states that the user fired warning shots near target 1244, 83 seconds into the problem.

Periodic Updates (code 01)

Periodic updates are signified by a record coded 01, followed by the time at which the update applies. This record is followed by a number of sub-records, each of which describes the condition of one active target, at that time.

The periodic updates provide all pertinent information about the situation at a particular instant. A periodic update is automatically written when the problem starts. This initial update provides data about all the active targets, including any clutter. Thereafter, a periodic update is written each S seconds, where S can be set by the experimenter. These subsequent updates do not list the clutter targets again, as they never change position. A final update is written to reflect terminating conditions.

At each update time, a record is written *for each active target* expressing:
- track number
- bearing from own ship, in degrees
- range from own ship, in miles
- altitude, in feet
- speed, in knots
- heading, in degrees
- current threat assessment (u, f, or h for unknown, friendly, or hostile respectively)

Example Periodic Update

```
01    30   (this periodic update describes the problem status after 30 seconds)
 1024 045 044 001000 0445 124 u       (the first active target)
 1144 150 018 024500 0266 090 h
 1010 018 009 000000 0012 242 f
 1211 268 029 021432 0388 074 f
 1095 111 006 000000 0022 167 u       (the 5th active target)
```

User Actions (codes 02, 03, 05, 06, 07, 09, 11, 14, 15, and 60)

Each user action is recorded with a code that indicates what the action was, the time at which the action was performed, and the target involved (always the currently hooked target). In addition, a few of the action types produce an additional character to further describe the situation.

Hook target (code 02). This record type ends with a 2-digit number that is used by the Replay function within the simulation system:
`02    12 1024 04` (hook target 1024, 12 seconds into the problem)

Warn hooked target (code 03). This record type reflects the level at which the warning was issued and the radio band on which the warning was issued—(1) military or (2) international air distress:
`03    29 1024 21` (warn target 1024, 29 seconds into the problem, a level 2 warning (2), on Military Air Distress (1).

Fire warning shots (code 05).
`05    34 1024` (fire warning shots near target 1024, 34 seconds into the problem.)

Illuminate hooked target (code 06).
`06    50 1024` (illuminate target 1024, 50 seconds into the problem.)

Request visual ID of hooked target (code 07).
`07    55 1024` (request visual ID of target 1024, 55 seconds into the problem.)

Contact tower regarding hooked target (code 09).
`09    60 1024` (contact tower regarding target 1024, 60 seconds into the problem.)

Change threat assessment of hooked target (code 11).
`11    65 1024 friendly` (change assessment of target 1024 to friendly) (other codes are "hostile" and "unknown")

Clear hooked target from display (code 14).
`14    75 1024` (clear target 1024 from screen, at 75 seconds.)

Restore hooked target on screen (code 15).
`15    85 1024` (restore display of target 1024, at 85 seconds.)

Fire at hooked target (code 60).
`60    95 1024` (fire at target 1024, at 95 seconds.)

Replies and Target Actions (codes 04, 08, 10, 50)

The remaining codes refer to actions by other crew members and by targets.

The warned target replies (code 04)
`04    69 1024`   (target 1024 identifies itself in response to warning, at 69 seconds) This record is not written if the user does not receive a verbal response from the warned target (because of equipment malfunctions). The nature of the self identification is whatever the experimenter established for the warned target.

The bridge responds with a visual ID attempt (code 08)
`08    77 1024 y` (the bridge responds with visual ID of target 1024 at 77 seconds) The code 'y' signifies that the bridge was able to make some kind of identification of the target, the nature of which is whatever the experimenter established for that target. Alternatively, the code 'n' signifies that the bridge was not able to make an identification due to excess range, poor light, or atmospheric conditions (or the target was clutter).

The tower responds (code 10)
`10    87 1024 y` (the tower responds concerning target 1024 at 87 seconds) The code 'y' signifies that the tower verifies that the tower is controlling a commercial airliner in the vicinity of (within 5 miles) the hooked target and within 5,000 feet of its altitude. Alternatively the code 'n' signifies that the tower denies that it has control of an airliner in the position and altitude indicated by the user.

A target fires on own ship (code 50)
`50    97 1024` (target 1024 fires on own ship at 97 seconds)

Changes to the Simulation Display (code 30)

Code 30 signifies that the user changed some element of the simulation Display. For consistency and ease of data analysis, this record type is in the same format as all other data records, although the track number of the hooked target has no real bearing on this record type. Following the hooked target track number is one blank and then digits that indicate which type of display element was changed, and its new value.

The characters following the hooked target track number are these:

1 changed visibility of commercial airline routes
2 changed visibility of commercial airline schedule
3 changed visibility of velocity leaders
4 changed visibility of missile ship circle
5 changed visibility of track numbers
6 changed radar range

Following the digits 1 through 5 is a blank and then 'v' or 'i' to indicate that the display element is visible or invisible. Following digit 6 is a blank and the new radar range, as a 3–character number.

Examples

`30  107 1024 1 v`	(user sets commercial air routes to visible)
`30  147 1024 2 i`	(user sets commercial air schedule to invisible)
`30  153 1024 6 016`	(user sets radar range to 16 miles)

An output file for an exercise might look like the following:

```
P28.7                                             (participant P28, problem number 7)
Thu Sep 8 00:08:48 1994                           (date and time exercise was run)
OffCourseAirLiner                                 (name of configuration for this exercise)
001 30 1 1 12:30                                  (environmental conditions)
  10                                              (file write interval, seconds)
 4 1                                              (number real targets, number clutter targets)
1024 045 044 001000 0445 124 u    (initial conditions of the 5 targets)
1134 150 018 024500 0266 090 u
1543 018 009 000000 0012 242 f
1754 268 029 021432 0388 074 u
7001 111 006 000000 0000 000 f (this clutter target will not be listed again)
02    8 1134 06                                   (hook target 1134, 8 seconds into exercise)
01   10                                           (periodic update at 10 seconds)
1024 045 043 001050 0445 124 u
1134 151 018 024800 0266 090 u
1543 018 009 000000 0012 245 f
1754 265 030 021432 0388 075 u
02   19 1754 24                                   (hook target 1754 at 19 seconds)
01   20                                           (periodic update at 20 seconds)
1024 045 043 001050 0445 124 u
1134 151 018 024800 0266 090 u
1543 018 009 000000 0012 245 f
1754 265 030 021432 0388 075 u
03   37 1754 21                                   (warn target 1754)
..
..
04   69 1754                                      (target 1754 replies to warning)
..

..
07   85 1754                                      (request visual ID of target 1754)
..
30  103 1024 6 016                                (user sets radar range to 16 miles)
..
08  107 1754 y                                    (bridge returns visual ID of target 1754)
..
..
99  480  120  7 0  0  2 etc. (end of problem at 480 seconds; score 120)
```

Authoring Mode

To author exercises, start the system using the name *author*. This allows certain keyboard commands to be made, and it provides access to a scenario configuration screen which is unavailable to experiment participants.

Prior to running an exercise, the author may specify and save one or more sets of initial conditions. Additionally, the author may specify sets of *scheduled maneuvers*. These are real–time changes in headings, speeds, and altitudes of various crafts that are *not* a result of the user's actions.

Then, when the author clicks on **Begin**, the system:

1. restores the conditions of the latest configuration recalled by the author;
2. reads in the latest scheduled maneuvers recalled by the author, if any; and
3. starts the exercise running.

The author's actions on each exercise are written to the file named *author*, with data for each problem replacing the prior data.

Thus, an exercise can be run multiple times, each time starting with the same conditions and each time involving the same scheduled maneuvers. Alternatively, the author can recall different conditions, and can modify and save different problem conditions. To change conditions, follow the instructions below, then save the revised configuration.

Backing Up Exercise Configurations

Configurations represent a considerable effort invested in establishing useful experimental conditions. Consequently, they should be backed up to diskette in case of hard disk failures or inadvertent changes caused by accidentally saving to an existing configuration name.

Exercise Creation or Modification

An exercise is specified in terms of 1) *initial conditions* and 2) optional scheduled *maneuvers* of targets. These two sets of information are independent, thus an experimental trial can involve any selected initial scenario configuration, and any selected specification of scheduled maneuvers, or none.

Initial Conditions

Initial conditions (scenario configurations) are established by 1) specifying the characteristics of the various targets that will be involved in the scenario, and 2) setting *external conditions* by making selections on the Scenario Configuration screen for such factors as weather and the operability of the simulated communication equipment of the user's ship. Target characteristics include such factors as target positions, headings, speeds, altitudes, intentions, and equipment operability.

Any unique set of initial conditions can be saved in a file named by the author. The configuration name is not seen by the participant, thus it can be descriptive of the situation, such as *terroristAttack*, *offCourseAirliner*, or *failedReceiver*.

Setting Initial Scenario Conditions

The general steps in defining initial scenario conditions are these:

1. Press ‘s’ to move to the Scenario Configuration screen (Figure 2), and enter the name of the configuration that is most similar to the one to be specified into the Get Scenario box (click in the box, key in the file name, press Enter). See Appendix D for the names of the configurations supplied with the system.

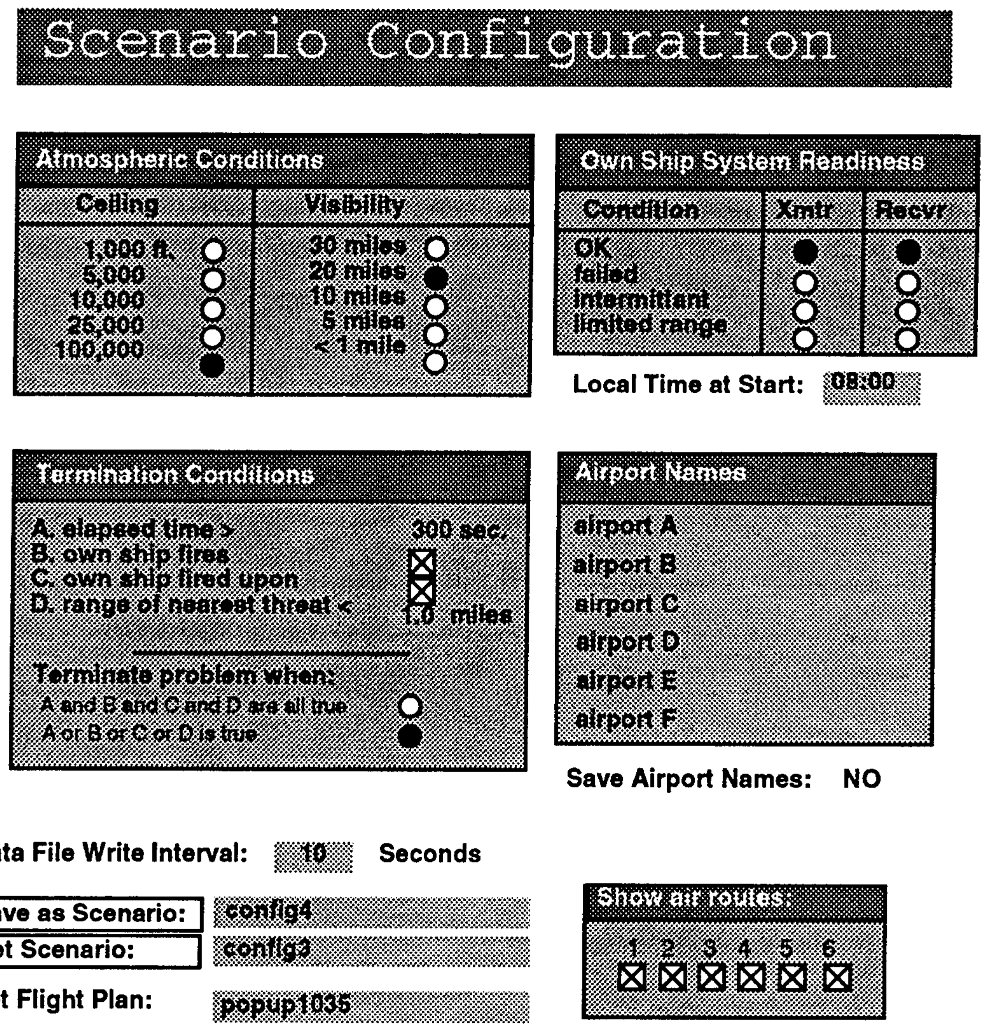


Figure 2. The Scenario Configuration Screen

Press ‘s’ again to return to the simulation screen. All the visible (active) targets for the retrieved configuration are seen in their initial positions on the radar screen. The remaining (*inactive*) targets are initially invisible.

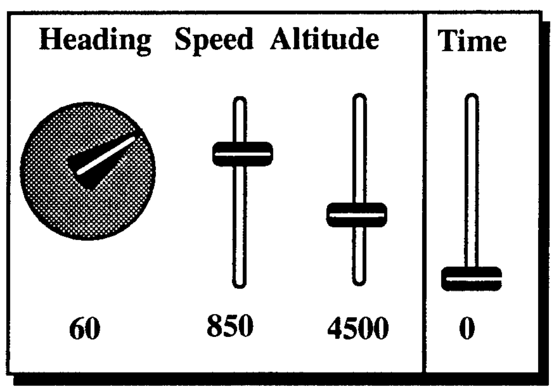
2. To bring a new target into the simulation, first make the inactive targets visible by pressing the ‘v’ key. Now four ‘stacks’ of targets will be seen below the radar circle, one stack for each type of target (air, surface, subsurface, clutter).

   To bring in a new target:
   a. click on the stack holding the target type desired. This will select the top target of that type.
   b. hold down the ‘m’ key (for *move*) and click on the radar screen where the selected target should be positioned. The selected target will move to that position. Further refinements in position can be made at any time by selecting a target then clicking at its new position with the ‘m’ key depressed.

   To ‘remove’ a target from a scenario, move it from the radar screen back to its stack (again, click on the target, then click on its stack while holding down the ‘m’ key).

3. For each active real target (i.e., not clutter), set its speed, altitude (if air), and heading by doing the following:

   a. press the f key (for fly-by-wire), and observe the following control box:



   b. Slide the Time control to zero **(this is very important)**.
   c. Select a target by clicking on it (clutter targets cannot be configured).
   d. Operate the three controls to establish the target’s speed, heading, and altitude. The target will respond instantly to these controls.
   e. Repeat steps c and d for all non–clutter targets.

When all targets have been set up, press the f key to make the ‘fly-by-wire’ controls disappear.

4. Specify the behaviors and characteristics of the active targets by doing the following:
   a. Press the c key (for configure target).
   b. Select a target by clicking on it.
   c. Make selections and entries in the target configuration box, as detailed below.
   d. Repeat steps b and c for all targets.

When all targets have been defined, press the *c* key to dismiss the configuration box.

5. When the initial target conditions are as desired, move to the Scenario Configuration screen by pressing the s key. Set the Atmospheric Conditions, Own Ship Readiness, Local Time, Termination Conditions, Data File Write Interval, and airport names (optional) as detailed below.

6. Save the scenario configuration by entering a name to the **Save as Scenario** box. (click on the scenario name box, key in a legal file name, press Enter). When the Enter key is pressed, the target characteristics set in steps 2 through 4 and the external conditions set in step 5 are written to the file you have specified as the scenario configuration name.

7. Run the exercise by returning to the simulation screen (press s) and clicking on **Begin**. The label of the Begin button changes to Stop, and the clock starts to run.

As an author, you can halt a problem by clicking on **Stop**, or pause a problem at any time. Each time an author clicks on **Begin**, the system restores the latest configuration saved or retrieved, and starts the simulation running in real time.

Note: If an author Gets a configuration, then makes some changes, then clicks on Begin, the problem will run, starting at that newly revised condition. That condition is lost, however, unless the author saves the modified configuration prior to running the problem.

The following provides more detail on the steps outlined above.

Configuring Individual Targets

The simulation comes stocked with a fixed number of surface vessels, submarines, aircraft, and clutter (see Appendix A). Each of these, generically called 'targets', maintains its inherent type for all time, i.e., an author cannot change a ship into an aircraft. Each target carries a unique 't' number that identifies it. Only the author can see this reference ID, in the Target Configuration box, described below.

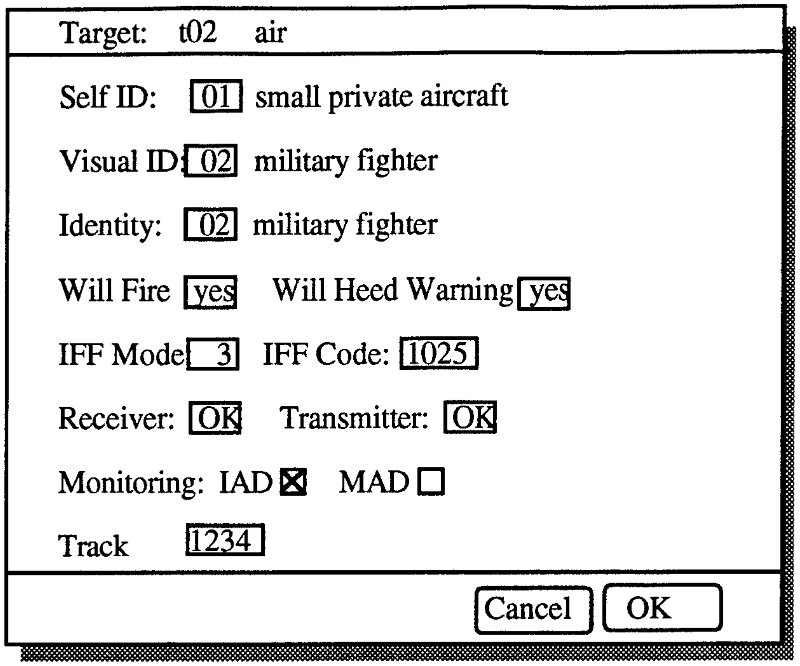
Authors can shape each target within its own class. For example, target T01 could be a helicopter in one scenario, and a jet fighter in another configuration. Specifications for a particular target apply to the *configuration* in which that target is saved, i.e., a target may be used differently in different configurations.

Clutter targets need not be configured by the author; they are preset to appear as aircraft–type symbols on the screen, but they will not respond to any commands, they cannot be seen when a visual ID is attempted, nor will they move about.

To set the characteristics of targets (step 4 above) press the **c** key (for configure). The following box will appear (if a target is already selected, its characteristics will display in the box, otherwise the data in the box will be blank).

Select the target to be specified, and observe its current characteristics.

Boxes containing numbers are set by clicking in the box, keying in a number, then pressing Enter. Boxes containing OK or yes/no or checks are set by clicking in the box.



Self ID, Visual ID, and Identity all refer to verbal descriptions contained in the ASCII file named CICDescriptions. These are not used for clutter targets, thus it doesn't matter what text is displayed here for a clutter target. **The entry is the line number in this file that contains the verbiage desired.** This file, CICDescriptions, can be edited and extended to establish any verbal descriptions desired. Each description must be one line in the file.

In the example shown above, line 1 of CICDescriptions contains the phrase
small private aircraft
while line 2 contains the phrase
military fighter

Self ID is the response a target returns to the ship when asked to identify itself. If desired, this could refer to a record in the CICDescriptions file that contains " ", i.e., silence. The Self ID can be truthful or devious.

Visual ID is the response given when the bridge is successful in making a visual ID. Generally, this is a general description, such as "military aircraft" or "commercial vessel".

Identity is the true identification of the target.

If a number is entered for any of the above three which is greater than the number of lines in the CICDescriptions file, the text shown will be **** EOF **** (End of File).

Will Fire specifies whether the target will fire on the ship or not (i.e., whether it is *hostile*). See IFF Mode, below, for the range at which various targets will attack. Once one target has fired on own ship, within a problem, no other targets will fire. Generally, a target firing on own ship should terminate a problem.

Will Heed Warning specifies whether the target will heed warnings that it receives. A target can be set up as hostile (will fire), but to heed warnings if it receives them. This represents a target that will attack if possible, but not unless it thinks it is safe to do so. A hostile target that will not heed warnings will attack whether warned or not.

IFF Mode is a digit (0, 1, 2, 3, or 4) which describes the target to the simulation system. This should be set to 0 for non–military ships and aircraft; to 1, 2, or 4 for military ships and aircraft; and to 3 for commercial airliners. This digit is used along with the target type (surface, air or subsurface) to determine whether or not it senses being illuminated, and the range at which it would fire on the user's ship, if it is hostile.

The simulation system uses IFF mode as follows:
Only military *aircraft* (IFF mode 1, 2, or 4) can sense being illuminated.
Only commercial airliners (IFF mode 3) are recognized by the land–based tower.
Hostile ships and aircraft with IFF mode 0 attack within 2 mile range.
Hostile ships and aircraft with IFF mode 1, 2, or 4 attack at 10 miles range.

Thus, IFF mode 0 describes a small non–military craft that could carry a weapon of some limited type.

IFF Code is currently unused.

Receiver and **Transmitter** refer to the operability of the *target's* radio equipment. By clicking on this field, for either Receiver or Transmitter, the value will cycle through the following values:

OK
intermittent (works half the time)
limited range (10 miles effective range)
failed

Monitoring specifies which radio bands are monitored by the target. None, one, or both boxes may be checked (checked means the band *is* monitored by the target).

Track is the track number to use for the target. This is the 4–digit number that will appear on the radar screen for that target. Use track numbers 7xxx for clutter.

After setting a target as desired, click on another target and set its characteristics. Continue to set target characteristics until all are set as desired. Then click on **OK**.

> Note that these target characteristics set as described above are not saved until the configuration is saved (on the scenario configuration screen).

Specifying External Conditions

The author can establish additional conditions on the Scenario Configuration screen (Figure 2). To make this screen appear (or disappear), press the **s** key (for scenario), then set the following conditions:

Atmospheric Conditions
- Ceiling — the altitude above which targets cannot be seen, during daytime.
- Visibility — the distance beyond which targets cannot be seen, during daytime.

Own Ship System Readiness, the operability of own ship's transmitter and receiver. Limited Range means transmitter or receiver has an effective range of 10 miles.

Local time (24–hour clock) at the start of the problem, which affects ability to visibly observe targets, and possible presence of commercial airliners, per their schedules.

Termination Conditions
The author can specify what causes an exercise to terminate. The four variables that can be used to terminate exercises are:
A. Elapsed time, in seconds. Enter a large number (like 9999) if elapsed time is not to be considered in terminating a problem.
B. Own ship fires. A check mark indicates that this variable is part of the termination condition.
C. Own ship fired upon. A check mark indicates that this variable is part of the termination condition.
D. Range of nearest threat. Enter miles, to one decimal place, if this variable is part of the termination condition.

And/Or selection. If more than one of the above four variables has been set, select the **And** button or the **Or** button to specify whether just one or all specified conditions are required to terminate the problem.

Example:
If elapsed time is set to 400, B is checked, C is not checked, D is 1, and the OR button is checked (terminate when A or B or D is true), the problem will terminate when elapsed time reaches 400, or when own ship fires, or when the range to the nearest hostile is 1.

Data File Write Interval.
The author can specify how often the target data will be written to file, thereby affecting the size of the output file. If a short time, such as 1 or 2 seconds is specified, the system will attempt to update the simulation and write to file as often as requested, however the speed of the host computer and the number of targets involved in the scenario might prevent the system from updating as rapidly as requested. The output file indicates the time at which the targets were updated, so the author can determine if the system is able to meet the request, on a particular host computer.

Airport Names
Airport names can be specified in a file named portNames. If this is done, the names entered there will be used for all exercises until, or unless, a scenario is run that contains its own names. To apply specific names to a scenario, enter the desired names on the Configuration screen, and then set the Save Airport Names: setting to YES (by clicking on it), prior to saving.

Scheduled Maneuvers

Scheduled maneuvers are changes in speeds, headings, and altitudes of various targets that are pre–ordained, i.e., they are carried out regardless of actions taken by the user of the simulation. This allows the developer of an exercise to create a wide variety of actions that are not under the control of the CIC decision–maker.

Defining Scheduled Maneuvers

Scheduled maneuvers by ships and aircraft may be specified independently of the scenario configuration. Scheduled maneuvers are changes in heading, speed, or altitude, over some time period, of various ships or aircraft. Clutter targets cannot be maneuvered.

Each set of defined maneuvers is saved in a file, so any particular scenario (set of initial and external conditions) could be run with different maneuvers. The author can specify maneuvers in two alternate ways:

1. by using the fly–by–wire controls to change headings, speeds, and altitudes as a scenario runs; or
2. by editing a text file that specifies the maneuvers of various craft.

Since the first of these techniques produces a text file, the two techniques can be used in combination as well, allowing the author to initially 'demonstrate' maneuvers with the displayed controls, but make minor corrections directly in the resulting text file if desired.

Specifying Scheduled Maneuvers with the Fly–by–Wire Controls

To specify maneuvers during a problem do the following in authoring mode:

1. Set up any initial conditions desired, save the configuration if desired, and click on the **Begin** button.

2. When the simulation reaches a point at which a maneuver is desired, click on the **Pause** button.

3. Press the f key to display the fly–by–wire controls.

4. Select the target to be maneuvered, if it is not already selected.

5. Slide the Time control to display the time period over which the maneuver is to take place (**this must be greater than 0**). A change of heading that requires 15 seconds would be indicated by sliding the Time control to display 15.

6. Slide the Heading, Speed, or Altitude control to the desired new value, and release the mouse. If desired, change one or more of the three target characteristics (it is not necessary to reset the Time slider unless a second change should take a different time). **No visual response will be seen in the selected target at this time, since the problem is paused.**

7. Resume the problem (the fly–by–wire box can be left on–screen, or removed by pressing f again), and note that the maneuvered target changes to the limit requested, in the time specified.

8. Repeat steps 3 through 7 to specify as many maneuvers as desired. There is no requirement that one target's maneuver be completed before another is specified.

9. Stop the problem.

At this point, all maneuvers that were specified via the controls have been written to a data file named **flightPlan**.

10. *Before running another exercise*, rename the flightPlan file to some other name of your choosing (running the simulation again will wipe out the previous file). If desired, you can make direct text edits to the file by referring to the following section. This is the easiest way to modify an existing maneuvering file.

11. Test the maneuvers by Getting the newly named flight plan on the Scenario Configuration screen, and running the simulation. The previously recorded maneuvers will be repeated.

Specifying Scheduled Maneuvers in a Text File

Any number of text files can be created to specify scheduled maneuvers. The files can be copies of the flightPlan file created via the fly–by-wire controls, as described above, or they can be created from scratch using a text editor. The format of the file is as follows:

First line. The first line in the file is not used, but there must be a first line that contains some text. A good use of this line is to state what the file describes.

Data Lines. The remaining lines in the file, except for the last line, contain the maneuvering data, one line per maneuver, in the following format.

Start Time	T #	Attribute	Attribute Value	Time Interval
0016	01	h	00180	10
0036	01	s	00060	05
0050	02	a	02250	20

Characters 1 through 4: The time, in seconds, at which the maneuver is to start.
Characters 5 through 6: The target number involved (the target's T number).
Character 7: Enter h for heading, s for speed, a for altitude change
Characters 8 - 12: The ending value for the heading, speed, or altitude
Characters 13-14: The duration, in seconds, required to execute the maneuver.
(enter 01-99 for duration less than 100; else enter C1-C9 for 100-900 seconds)[2]
Last line. The last line must contain 'end'.

Example Maneuvering File:
authored maneuvers
001601h0018010
003601s0006005
005002a0225020
end

Here, the first data line says: Change the heading of target 01 to 180 over 10 seconds, starting 16 seconds into the problem.

[2] The C1 through C9 syntax was introduced in Version 2.6

Retrieving Scheduled Maneuvers

As an *author*, you can invoke any existing file of specified maneuvers by Getting a Flight Plan on the Scenario Configuration screen (click on the Flight Plan name box, key in the name of an existing flight plan file, and press Enter). When an exercise is started, the system will automatically produce the specified maneuvers. You could then change scenarios, but leave the maneuvering file the same, and click on **Begin** again. The initial conditions would change, according to the new scenario, but the maneuvers would be the 'same', i.e., the limits specified would be achieved.

If you do not want any maneuvers to be performed during a problem run, as an author, clear the Flight Plan box by clicking in it, then pressing Return. All problems run, *as an author*, will then involve no maneuvers.

To invoke maneuvers for *experimental participants*, include maneuvering file names in the SessionPlan file, as described next.

The Session Specification File

An experimental session is specified in an ASCII file named SessionPlan (note capitalization of file name). This file lists predefined configurations which form the basis of exercises. Optionally, it can invoke previously defined scheduled maneuvers.

<u>Line 1.</u>
If problems are not to be generated randomly, the first line can contain any text that is useful in identifying the particular file when it is printed. *This line is required.*

<u>Line 2.</u>
The second line indicates the *preferences* for a session. Seven digits are entered:
Digit 1: Replay allowed by anyone?
    1 means allow Replay by experimental participants, as well as authors
    0 means allow Replay only by *author*

Digit 2: Pause allowed by anyone?
    1 means show the Pause button regardless of the user's name.
    0 means show the Pause button only if user is *author*

Digit 3: Instructional data level (0, 1, or 2). See section *Task Orientation and Instruction.*

Digit 4: Time Warp allowed by anyone?
    1 means respond to Time warp command (t entry) from *anyone*
    0 means only respond to Time Warp command from *author.*

Digit 5: Knowledge of results displayed at end of problems?
    1 means do allow user to learn true target identities at the ends of problems
    0 means do not provide true target information at the ends of problems

Digit 6: Performance score displayed at end of problems?
    1 means do display a score at the end of each problem.
    0 means do not display a score at the end of each problem.

If digit 6 is 1, the next line in the SessionPlan file must provide a set of weights to use in computing the score, as described in the section **Scoring**.

Digit 7: Scaling factor to use to decrease built-in delays.
Delays up to 45 seconds have been purposely built in to the simulation. For example, after warning a target there is a 20-second delay before that target responds. This delay provides high realism, but can complicate experimentation with novice operators. The experimenter may therefore enter a digit, from 2 to 9 which will factor the normal time delay for each activity type.

The author can always replay problems, pause/resume problems, and warp time. The preferences line allows the experimenter to provide these options to experimental participants, if desired. In most machine learning applications, particularly in runs used to train the learning system, the learning program's performance is not written to file. In some other cases, however, it may be desired to capture the learning program's performance, just as if it were a human user. The third digit in the preference line provides control over this function.

Following Lines

The remaining lines in the SessionPlan file, except for the last line, list names of predefined configurations and, optionally, scheduled maneuvers, as described later. If the first line of the file does not call for random problem generation, the system will produce exercises using the listed configurations in order. In any case, problems end when the configuration's problem termination condition has been met.

The last line of the file must be the word *end.*

Example SessionPlan.

General Plan 1	(problems will be generated in the fixed sequence listed below)
0101101	(the preferences for the session, with no scoring)
MyScenario1	(the name of the first exercise, or configuration)
SingleAttack	(the name of the second exercise, or configuration)
OffCourse	(the name of the third exercise, or configuration)
Terrorist3	(the name of the final exercise)
end	(end of file)

The second line specifies these preferences:
Replay only by authors; anyone may pause/resume; no machine data written; anyone may warp time; do allow user to learn true target identities at problem end; and do not display a performance score at the end of each problem.

Automatic Problem Generation

Problems can be generated automatically, either in a systematic progression of situations, or in a random fashion. In either case, the automatically produced problems are variations on predefined configurations. The six variables manipulated are these:

• time of day, 2 possible conditions (14:00 and 22:00).

• radar clutter conditions, 3 possible conditions (none, moderate, heavy)

• own ship's equipment operability
  transmitter, 4 possible conditions (OK, failed, intermittent, limited range)
  receiver, 4 possible conditions (OK, failed, intermittent, limited range)

• atmospheric conditions
  ceiling, 5 possible conditions (1000; 5,000; 10,000; 25,000; and 100,000 feet)
  visibility, 5 possible conditions (30, 20, 10, 5, or 1 mile)

These provide for 2400 different problems per configuration. Target characteristics (the number and types of targets, their speeds, headings, etc.) are *not* altered. Thus, a configuration can be simple or complex, owing to the number and types of targets, yet it can be made materially more or less difficult by the values selected for the variables.

When a problem is generated with no radar clutter, none of the clutter targets specified in the basic configuration are displayed. Under moderate conditions, half of the clutter is shown. Under heavy clutter, all the active clutter targets of the configuration are displayed. Thus the maximum amount of clutter is determined within the configuration. If a configuration has no active clutter targets, therefore, there will be no clutter targets displayed regardless of the clutter conditions being used in automatic problem generation. This approach allows the experimenter to custom–position clutter targets, to either simplify or complicate a problem.

> It is recommended that at least four clutter targets be provided if problems will be generated automatically, so that all problems will be different.

Random Problem Generation

To generate problems randomly, over all the configurations listed in the SessionPlan file, make the first line in the SessionPlan file read as follows:

```
randomize <number of problems> <seed>
```

where <number of problems> is the total number of problems to generate and <seed> is either zero or some positive integer. For example:

```
randomize 5000 12345
```

The number of problems can be any integer. If seed is zero, the system will initialize random number generation using the system clock, thus the sequence of problems is not repeatable from one session to another. If seed is not zero, the system will initialize the random number generator using seed, thus the problems will be generated randomly, but in a repeatable manner. Random selection is *with replacement*, but the system never selects the same configuration twice in a row.

Whenever problems are generated randomly, the system creates a file named scratchFile. This file can be removed anytime sessions are not in progress.

Example:

randomize 3500 5432 (randomly generate 3500 problems, with seed 5432)
010100
MyScenario1
SingleAttack
OffCourse
Terrorist3
end

Sequential Problem Generation

Problems can also be generated in a sequential fashion, each being a systematic variation of its basic configuration. To generate problems sequentially, add the number of problems to be generated to any configuration named in the SessionPlan file (add 1 space then the number of problems). Example:

Session Plan 2	(problems not generated randomly)
0101001	(preferences; no scoring)
MyScenario1 20	(run 20 problems with this configuration)
SingleAttack 8	(then run 8 problems with this configuration)
end	

Specifying Scheduled Maneuvers in the Session

To effect scheduled maneuvers during a problem, add the symbol '+' and a scheduled maneuver file name to any configuration line (no embedded blanks). For example, the following SessionPlan file calls for making the maneuvers specified in the file **scary** on the first two problems, and the maneuvers from **sneaky** on the last 10 problems:

Session Plan 3	
010110	
MyScenario1+scary	(run MyScenario1 with scary maneuvers, once)
OffCourse 5	(run OffCourse with no maneuvers, with 5 variations)
Terrorist3+sneaky 10	(run Terrorist3 with sneaky maneuvers, 10 variations)
end	

Replaying Exercises

The author can always replay completed exercises, and experimental participants may do so if the preferences in the SessionPlan file allow. The option exists to either replay the just–completed exercise, or any other previously–completed exercise. Thus, the replay capability provides a way for an instructor to 'demonstrate' expert performance and have others observe that captured performance at another time and place.

To replay a problem do this:
a. Upon completion of a problem, press the 'r' key, and observe the replay box.

Replay: Previous Problem

b. To replay an exercise *other* than the previous one, key in the exercise name (click on Previous Problem, key in the name of a file that contains the data for a previously–completed exercise, press Enter). Otherwise, proceed to step c.

c. Press **Begin**, and watch the problem play out as just performed. You will observe a message that indicates each action performed by the user, and you will see the influence of that action on the simulation.

Replay: Previous Problem
Hook target 1122

Problems may be replayed multiple times by pressing **Begin** with the replay box visible. Problems may be Paused during replays, if desired. To start a new problem, press the r key to make the replay box disappear, then click on **Begin**.

Scoring the User's Performance

To display a performance score at the end of each exercise, set digit 6 of the preference line to "1". The performance score is calculated automatically by the simulation system, as:

score =
w1
+ w2 * closest hostile target
– w3 * firings on friendly targets
– w4 * firings on hostile targets that would heed warnings
– w5 * warnings at level 1 issued
– w6 * warnings at level 2 issued
– w7 * warnings at level 3 issued
– w8 * warning shots fired at friendly craft
– w9 * warning shots fired at hostile craft
– w10 * illuminations of friendly craft
– w11 * illuminations of hostile craft
–w12 * number of attacks by hostile craft (0 or 1)

where the coefficients w1 through w12 are weights that apply to scoring during the session. Any of the weights may be set to 0.

If digit 6 of the preference line in the SessionPlan file is "1", then **the line following the preferences line must supply the weights**, a 36–digit number, representing twelve 3-digit weights, e.g.,

050020050020000002003020005010000100

The following is an example SessionPlan file calling for scoring:

```
randomize 250 0                 (generate 250 problems randomly)
0101011                         (preferences; scoring enabled)
025020020050000002003020005025000100    (scoring weights)
MyScenario1
OffCourse
Terrorist2
end
```

The Scoring Algorithm

The primary objectives of the exercise are to minimize threat to own ship from other craft while avoiding inappropriate defensive actions. Secondarily, the more skilled decision–maker will limit intrusive threats or warnings to situations deserving them, while less–skilled decision–makers may employ such actions inappropriately. The structure of the scoring algorithm is set up to recognize both the primary and secondary factors.

The scoring algorithm provides the experimenter considerable flexibility in weighting various actions. Its basic structure provides the ability to begin an exercise with a constant score (w1), to add to this constant according to the user's ability in keeping hostile craft away (w2), and to subtract from this according to the occurrence of undesirable events. By assigning proper weights, the experimenter can discourage overuse of warnings (including illuminations), even though issuing of warnings is not inherently negative. In essence, warnings can be employed at some 'cost' as an investment to keep the score high by avoiding approach or attacks by threatening craft or taking inappropriate defensive measures. The 'costs' associated with contacting land–based towers or calling for visual identifications are not included in the score. These actions, if overused, consume the user's time and attention, but if used properly can assist in conducting the task well.

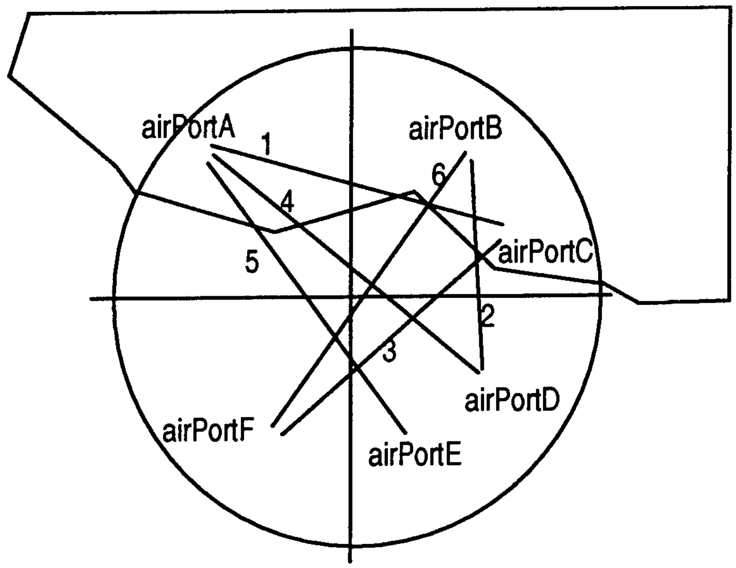
Specifying Commercial Air Routes

The simulation provides six commercial air routes, shown as dotted orange lines when the user sets the Commercial Air Routes check box in the Display section to checked. The author can control which of the six air routes are displayed *during authoring* by checking the routes desired on the Scenario Configuration Screen. The figure below provides the numbers of the six routes between the six airports.

In general, increasing route numbers relate to increasingly threatening courses. The selection of air routes is independent of scenario configuration, i.e., any configuration can be run with any assortment of commercial air routes.

The experimenter may call for any mix of the six routes to be involved in a problem, using an input line starting with the word *routes*, within the SessionPlan file. The following is an example: routes 001011

This particular input causes air routes 3, 5, and 6 to display *when the air routes box is checked by the user.* The input line must be exactly as shown, with one space following the word *routes*, then 6 digits that are 0 or 1. Authors are responsible for setting up the commercial airliners to follow the routes or not, as they like.



Multiple *routes* input lines can be embedded in the SessionPlan file. Each one establishes the air routes that will be shown (when requested) until the next *routes* input line, if any. The first *routes* input line must come somewhere after the preferences line and its following weights line, if any. The following is an example:

Plan 5	
0101111	(preferences)
025020020050000002003020005025000100	(scoring weights)
routes 111000	(enable only commercial air routes 1, 2, and 3)
MyScenario1+scary	(run MyScenario1 with scary maneuvers, once)
routes 100001	(enable only commercial air routes 1 and 6)
OffCourse 5	(run OffCourse with no maneuvers, in 5 variations)
Terrorist3+sneaky 10	(run Terrorist3 with sneaky maneuvers, 10 variations)
end	

Thus, in the foregoing SessionPlan file, routes 1, 2, and 3 are enabled (displayable) for the first problem, while routes 1 and 6 are enabled for the following fifteen problems.

The system enables all six routes by default at the start of an experimental session, in case problems are run with no preceding routes specification.

Specifying Airport Names

The author can set the names of the six airports involved in commercial air travel. To association different names with each scenario, define them and save them as outlined earlier. Alternatively the author may define a set of names to be used for an entire session (until or unless a scenario is run that provides its own names; in this case these newer names are used until overridden by another scenario containing custom names).

To define names to be used for a session, create a text file named portNames, entering one name per line. The names are assigned in the order listed to airportA, airportB, ..., airportF as shown in the preceding diagram.

Example:

```
Milwaukee
San Francisco
Gerberville
Paris
Nome
Akron
```

Printing

The simulation screen may be printed at any time using the print menu item under View, however the proper print command may vary from one installation to another. Each user should key in whatever Unix print command works for the system involved.

The default print line works for SCO Unix.

For Linux users, complete the print command to read:

```
lp -o raw -d lp
```

Machine Learning Mode

The CIC simulation can be set up to communicate bi-directionally with a machine learning program, hosted either in the same platform or over a network. The 'setup' is accomplished simply by entering the name 'machine' to the CIC system when it is started.

Two data files, *MLData* and *Status*, are used for inter-processor communication. File MLData is used by CIC to inform the machine learning system about the progress of a scenario, and it is used by machine learning models to communicate decisions back to CIC. The Status file is used to control and mark who has control of the process. When CIC is ready to turn control over to machine learning, it writes "GOML" into Status (this will be the only record in the file). When machine learning is ready to turn control back to CIC (after writing out its decision to the MLData file), it writes "GOCIC" as the only record in Status.

Data Communicated to the Machine Learning System

In machine learning mode the CIC system communicates four kinds of data to the outside world: 1) initial conditions, 2) periodic updates which provide current information about the simulated world, 3) actions performed by other simulated people in the scenario, and 4) an end-of-problem marker.

Initial Conditions. At the start of each problem, the CIC system writes out to the MLData file a complete image of the starting conditions of the scenario. This block of data starts with the record "MLData", and ends with the specifications for each active target, plus clutter, in the exercise. Note that this initial header data does not start with the code "01" that precedes all subsequent periodic updates.

Periodic Updates. Every few seconds during the simulation the CIC system writes out to the MLData file a complete 'snapshot' of the scenario at that instant. This file write is done each time the graphical display is updated, i.e., the machine learning system will receive the same information, in data form, that a human operator would perceive visually. The data format of the MLData file is that described under Periodic Updates, above (each periodic update starts with a record "01" followed by the update time).

Actions of Others. The CIC system also broadcasts the performance of actions by people other than the decision-maker. These actions are:

Action	Code
the warned target replies	04
the crew returns a visual identification	08
a land-based tower responds to a query	10
a hostile target fires on own-ship	50

Other characters follow these codes, giving the time of occurrence, and if appropriate the track number of the acting target. See section *Replies and Target Actions* for the complete formats. If the machine learning system needs to know exactly what a warned target says when it replies, it can refer to the ASCII file which generated that text (file CICDescriptions), in reference to the configuration being run (which is specified in the configuration file).

End–of–Problem Marker. At the conclusion of each problem, the CIC system writes the code "99", followed by the total elapsed exercise time, and the performance score, to MLData. At this point, the machine learning system can write out any data files it uses, and it can prepare to start the next problem. When it is ready to proceed, it should write action code "00" to MLData, then write "GOCIC" to file Status.

Turn Taking

At startup, the machine learning system should write "WAIT" to the Status file, then monitor that file until it contains the record "GOML". Thus, the CIC system has the first real 'turn'. The initial data that CIC writes to the file MLData describes the initial scenario conditions. Following each write to MLData, the CIC system pauses until the machine learning system responds. During this pause, there is no activity in the simulation whatsoever, and passage of time is ignored.

The machine learning system can detect that new information is available for analysis if the first and only record of the Status file is "GOML". In this case, the machine learning system can read in the complete MLData file, and it can take as much time as necessary to digest the situation. Then it should:

1. write out a single record to the MLData file, indicating its decision, and **then**
2. write the record "GOCIC" to the Status file.

As soon as the machine learning system writes the "GOCIC" record to the Status file, the CIC simulation acts on any decision residing in MLData, and it resumes simulating until it is time to inform machine learning again.

Communicating Machine Learning Decisions

Each machine learning decision is represented via a 2–character ASCII decision–code, followed by a few extra characters for action codes "02" and "03". The action codes are shown in the table below ('hooked target' signifies the most recently hooked aircraft or sea vessel).

Action	Code	Plus
No action (continue with scenario)	00	
Hook a new target	02	4-character track #
Warn the hooked target	03	level (1,2,3) & channel (1,2)
Fire warning shots at the hooked target	05	
Illuminate the hooked target	06	
Request visual ID of the hooked target	07	
Contact tower regarding hooked target	09	
Fire at the hooked target	60	

These data are ASCII characters.

Two action types, *hook target* and *warn target,* require a few extra digits, as explained next.

Hooking (Selecting) Targets. Prior to performing any action involving a target, the decision-maker must identify, or 'hook' the target to be acted upon. To hook a target, write a record starting with '02', followed by the target's 4-character track number, e.g., 021524 means hook target 1524. Then, at each decision opportunity, the machine learning system can call out an action to take upon the hooked target. To act on another target, perform another hooking action, supplying the new track number.

Warning Targets. To warn the hooked target, write a record starting with '03', followed by the character '1', '2', or '3', signifying the warning level, and the character '1' or '2', signifying the radio channel (MAD is '1', IAD is '2'), e.g.,

0321	means warn the hooked target at level 2, on the MAD channel

Examples

021053	hook target 1053
05	fire warning shots near hooked target
0321	warn the hooked target at level 2, on the MAD channel
60	fire on the hooked target

Starting A Machine Learning Session

Start your machine learning system first. Then start the CIC simulation, entering "machine" as the user name, and then click on the **Proceed** button. All processing after this point is automatic. **Warning: do not use the mouse during a machine learning session.**

Your machine learning system should follow these procedures:
1. At start up, write "WAIT" to the Status file.
2. Monitor the Status file until it reads "GOML" or "STOP".
3. If STOP, the session is done. If GOML, compute a decision and write out the appropriate action code to MLData.
4. Write "GOCIC" to the Status file (one record, destructive write).
5. Go back to step 2.

If the machine learning system wants to stop, it should write "STOP" to Status at step 3, then do step 4, then it should wrap-up its own business and then stop. Alternatively, it could simply stop at step 3, leaving CIC in a waiting condition.

Restarting Machine Learning Sessions

The machine learning system can restart a session automatically by writing the key word '**RESTART**' to the Status file. A new CIC session will then commence.

Testing Communications

To facilitate testing of a machine learning configuration, a second RIDES program, testML, is provided. This routine allows you to make decisions manually that are then communicated to the CIC simulation, and it receives and displays the first record of each data dump which CIC makes to the MLData file.

Using testML, you can manually perform these actions:
- o hook either of two targets, (the 'first' being whatever target happens to be listed as the first target in the scenario, and the 'second' being the target)

• warn the hooked target (level 2 and the MAD channel are assumed);
• contact the tower about the hooked target;
• request a visual ID about the hooked target; and
• continue simulating (no action at this time).

Your machine learning system can invoke other actions, but these are sufficient to test the communication channels with CIC.

Here is the procedure for using testML with CIC.

1. Launch testML and CIC in any order, but don't start either one.
2. Start testML by clicking on its Start button. Its Start button turns red.
   Observe: ***Waiting for initial conditions from CIC.***
3. Enter "machine" as CIC's user name, if it is not already there, and click on Proceed.
4. After 5 - 10 seconds, the radar simulation screen will appear, CIC will write out the initial conditions to MLData, and testML will display:
   Initial Conditions received; continue.
5. Click on the bottom button, labeled "continue simulating". Each time a decision is indicated via a radio button, the buttons will disappear.
6. The CIC simulation will display ***ML decision: 00*** and it will make its first update to the scenario and write out a periodic update to MLData.
7. Now you will see the first record of the update in testML, something like **01 4** meaning a periodic update at 4 seconds. If you like, you can bring up the entire MLData file in a text editor and observe the full contents.
8. From this point on, you may make any of the decisions supported by testML by clicking on one of the radio buttons. Following each decision, CIC will display the exact action code it receives, it will update the scenario, it will write out a periodic update or a response to one of your actions (a reply from a warned target, a tower, or the crew member making a visual ID), and it will pause, waiting for another decision.

At the end of a problem, you will see the code 99 followed by the time. Click on proceed. If your sessionPlan file lists more than one problem, CIC will start running the next problem. To end a test session, click on the testML Stop button. While testML can be restarted simply by clicking on the Start button again, the CIC system must be restarted from the beginning, i.e., at the initial user identification screen.

Testing Machine Learning

The machine learning system has access to all of the data involved in a scenario (initial conditions, periodic updates, and actions by others), as well as its own decisions. Since execution time is of no consequence during the machine learning control phase, it can write out whatever data is useful to fully document the exercise. *Note that the CIC system does not write out exercise data to any other file than MLData, in machine learning mode.*

If desired, experimenters may observe the scenario while it is being run in association with a machine learning system. For convenience, the CIC system displays each decision that it receives in the lower user prompt area, in red letters, e.g.,

ML decision : 021534

Task Orientation and Instruction

Content

At the experimenter's discretion, orientation and instruction in the tactical decision making task can be made available to a user. The SessionPlan file is used to specify when and if instruction is available and the level of detail recorded about the user's study of the material.

The instruction covers eleven topics. The content is very fundamental, addressing the basic task objectives, the mechanics of operating and interpreting the simulated display, and the means and implications of issuing the various commands. The following table indicates the topics.

Topic No.	Topic
1	Task Objectives
2	The Radar Display
3	Target Symbols
4	Controlling the Radar Display
5	Hooking Targets
6	Warning Targets
7	Clearing and Restoring Targets
8	Identifying Targets
9	Acting on Targets
10	Begin, Pause, Help, and Replay
11	Exercise Conditions & Results

Because this task will be used under widely varying experimental conditions, there are two topics intentionally not discussed: 1) the specific scoring that will be used, if any, to measure the user's proficiency, and 2) geopolitical issues that affect the conduct of the task. These two topics may be addressed off-line, according to the conditions of the particular experiment.

In order to maximize the significance of the collected data, the user accesses a topic only by clicking on the topic name specifically. While other 'browsing' features, such as forward and backward arrows could be provided, they would make data interpretation more difficult since screens could be accessed that were not sought.

The experimenter controls when and if instruction is to be made available to the user and the level of detail in the recorded usage data. This is done by setting digit three of the session preferences line in the SessionPlan file. If the Pause mode is disabled when instruction is allowed, then instruction is only available between exercises. If Pause mode is enabled and instruction is allowed, then the user can access the instructional content during pauses in exercises as well as between exercises. The particular number entered in the Preferences line determines whether usage of instruction is recorded at a summary level or at a detailed level.

Controlling Availability of Task Instruction

There are three alternatives for the availability of instruction during a session:

1. Instruction is not available.
Set digit three to 0. The Help button which evokes instruction will not be visible to the user, and no instruction usage data will be written.

2. Instruction is available between exercises.
Set digit three to 1 or 2, and disable Pause mode by setting digit two to 0. A Help button will appear on the simulation screen before each exercise, including the first, providing access to the instruction. If the digit entered is '1', *summary* level data will be recorded for each exercise. If the digit is '2', *detailed* data will be recorded for each exercise.

3. Instruction is available between exercises, and during Pauses within exercises.
Set digit three to 1 or 2, and enable Pause mode by setting digit two to 1. The Help button will be visible prior to each exercise, and whenever an ongoing exercise is paused by the user. As above, a '1' for digit three signifies summary data, a '2' signifies detailed data.

Usage Data

Summary Level Data. If summary level data is specified, usage of the instructional material during a session is recorded entirely in a data file named <user name>.instn, e.g., **Smith.instn.**

If Pause mode is disabled, there will be two records per exercise in the data file. For each exercise performed, one record gives the exercise number, and the next indicates the total seconds devoted to each topic prior to that exercise. Each data record consists of eleven 4-digit numbers preceded by one blank, as shown in the following example:

```
Exercise 01
 0093 0403 0654 0000 0000 0000 1532 0000 0083 0392 0043
Exercise 02
 0064 0329 0423 0040 0055 0050 0055 0680 0064 0035 0465
etc.
```

This user spent 423 seconds studying topic 3 prior to exercise 2.

If Pause mode is enabled, there will be three records per exercise in the data file: the first record is the exercise header, the second gives the study times prior to the exercise, the third gives the times spent studying during Pauses within the exercise.

```
Exercise 01
 0093 0403 0654 0000 0000 0000 1532 0000 0083 0392 0043 (prior to)
 0000 0000 0093 0000 0000 0030 0000 0000 0000 0112 0000 (during)
Exercise 02
 0064 0329 0423 0040 0055 0050 0055 0680 0064 0035 0465
 0093 0403 0654 0000 0000 0000 1532 0000 0083 0392 0043
etc.
```

In this example, we know that the user spent 30 seconds studying the sixth topic during pauses in exercise one, but we don't know when in the exercise this occurred, or how many times this topic was studied. To know this, we use detailed recording.

<u>Detailed Data</u>. If Pause mode is disabled, all detailed data records are written to the user.instn file. The detailed data provides the same summary information described above, but in addition it indicates each usage of the instructional screens. Each usage record reflects the topic (screen) number studied, and the seconds spent in the following format:

<topic number, 3 digits>, **space, <total seconds,** 4 digits>

Following the detailed usage records is a record starting with '999', indicating that the next record is a summary record. The data records for the first three exercises of an example session are shown below (records for the first exercise are annotated).

```
Exercise 01
004 0058     (user spent 58 seconds on screen 4)
003 0014     (user spent 14 seconds on screen 3)
008 0156     (user spent 156 seconds on screen 8)
003 0063     (user spent 63 seconds on screen 3)
999 0000     (end of detailed records)
0000 0000 0077 0058 0000 0000 0000 0156 0000 0000 0000   (summary)
Exercise 02
999 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
Exercise 03
002 0038
005 0017
006 0375
007 0043
999 0000
0000 0038 0000 0000 0017 0375 0043 0000 0000 0000 0000
etc.
```

> Note that the Exercise header, the end marker, and the summary record are written, even if the user did not access the instructional screens prior to an exercise (as in Exercise 2, above).

If Pause mode is enabled, the detailed usage data file will reflect the usage of instruction *prior to* each exercise, and the user's task performance data files will contain records showing use of the instructional screens while in Pause mode.

A new action code, 31, is used to document the start of an instructional activity, while in pause mode of an exercise. The instructional activity records are embedded in the user's performance data file for the convenience of analyzing the data. Note, however, that in Pause mode, the simulation clock is not running. For this reason, the times spent studying instructional material are not reflected in the cumulative times of the periodic updates, and other normal performance records.

The following annotated example illustrates a section of a user's performance data file when detailed recording was requested and the user accessed instruction during a pause in an exercise.

```
...
...
...
01   85      (a periodic update of three active targets)
1024 045 043 001050 0445 124 u
1134 151 018 024800 0266 090 f
1543 018 009 000000 0012 245 f
31   98      (the user clicked on Help, while the exercise was Paused at 98 seconds)
004 0058     (user spent 58 seconds on screen 4)
003 0014     (user spent 14 seconds on screen 3)
008 0156     (user spent 156 seconds on screen 8)
999 0000     (user exited instructional screens)
01   89      (a periodic update)
etc.
```

When analyzing these data, note that the user could go to instructional screens, return to the simulation, then go to the instructional screens again before resuming the simulation.

Appendix E provides screen graphics for the instructional content.

Appendix A

Targets Provided

The CIC simulation is stocked with the following targets:

Target Type	Qty.
aircraft	20
surface vessels	15
submarines	3
clutter	20

The experimenter may employ any subset of these targets in a particular exercise, and may configure all aspects of each target, except that target type is fixed for each target.

Appendix B

Built–in Delays

One of the difficulties in using any complex man–machine system is the problem that commands, inquiries, and responses all consume time— there are significant delays in crew member responses to commands, and in responses by targets to actions taken by the decision–maker. The following lists the delays that are intentionally built–in to the CIC simulation to maintain high realism.

Defend Ship	15 seconds to fire at hooked target, following the order
Illuminate Target	45 seconds for illuminated target to respond, if it does respond
Contact Tower	30 seconds for tower to respond.
Visual ID	10 seconds for crew to attempt identification of hooked target
Warn Target	20 seconds for target to respond, if it does respond
Fire Warning Shots	30 seconds to fire shots, following the order

Scaling

Digit 7 of the Preferences line (line 2) of the SessionPlan file provides a means for scaling these delays from 1/2 to 1/9 of the nominal values shown above.

Appendix C

Summary of Key Commands

The following keys can be pressed by the author to effect various authoring functions:

c	Shows/hides the target **c**onfiguration box; used to configure selected targets.
f	Shows/hides the **f**ly-by-wire controls; used to set target speed, heading, altitude.
m	Used to **m**ove the selected target; click at the new position while holding down m.
r	Shows/hides the exercise **R**eplay box.
s	Shows/hides the **S**cenario configuration screen.
t	Shows/hides the **t**ime warp control; used to accelerate testing.
v	Shows/hides inactive targets, for the current configuration.
x	Shows/hides the target debriefing box.

The experimenter can also allow study participants to use the r and t commands.

Appendix D

Supplied Configurations

The following configurations are supplied with the CIC simulation software:

configuration Name	Nature of the Configuration
config1	All targets are active and arranged by target type
config2	Approximately half of the targets are active
config3	No targets are active
config4	A commercial airliner approaching
config5	An attack by a military aircraft

These configurations simply provide helpful starting points to create custom configurations. If a configuration will employ most of the available target types, config1 provides a useful basis. If very few targets will be involved, start with config3, and move the targets desired onto the radar screen. Config4 and config5 provide samples of configurations that could be used for experimentation.

In configuration config1, config2, and config3, the targets are set up as follows:

Tracks	Identity	Will Fire?	Will Heed?
1035, 37, 39, 41	small private aircraft	no	yes
1043, 45, 47, 49, 51	commercial airliner	no	yes
1053, 55, 57, 59	U.S. military aircraft	no	yes
1061, 63, 65	hostile military aircraft	yes	yes
1067, 69, 71	hostile military aircraft	yes	no
1073	comm'l airliner w/ no radio	no	not to radio
1122	friendly submarine	no	no
1123	hostile submarine	yes	yes
1124	hostile submarine	yes	no
1234, 44, 54	comm'l fishing ship	no	yes
1236, 46, 56	hostile ship	yes	no
1238, 48, 58	U.S. Navy ship	no	yes
1240, 50, 60	friendly military ship	no	yes
1242, 52, 62	hostile ship	yes	yes

These characteristics exist in relation to the CICDescriptions file, which has these entries (individual users of the software may be using different descriptions in their file):

Record	Description
1	small private aircraft
2	commercial fishing ship
3	military fighter
4	military aircraft of unknown origin
5	private helicopter
6	commercial airliner
7	friendly submarine
8	submarine of unknown origin
9	hostile submarine
10	U.S. Navy ship
11	friendly military ship
12	ship from hostile nation
13	clutter
14	U.S. military aircraft
15	hostile aircraft

Appendix E

Instructional Screens

The following pages are screen prints of the instructional screens provided.

Topics

Click on the topic you wish to study.

- Task Objectives
- The radar display
- Target symbols and Clutter
- Controlling the radar Display
- Hooking targets
- Warning Targets
- Clearing & Restoring Targets
- Identifying Targets
- Acting on Targets
- Begin, Pause, Help, and Replay
- Exercise Conditions & Results

Click below to continue with the exercises.

- Return to Exercises

Task Objectives

You are in command of a small crew onboard a Navy ship. Your task is to protect your ship from attack. You do this by monitoring a radar screen that shows all the ships and aircraft in the vicinity of your ship.

The ships and aircraft around you may all be friendly, or some of them might be hostile. You must attempt to determine who might pose a threat to your ship, and take measures to ward them away. As a last resort, you may command your crew to fire on a ship or aircraft that is threatening your ship.

You have control over the radar display, and you have a number of commands and messages you can issue. All of your actions are performed by clicking the left mouse button on various symbols on the screen. When you issue a command, you may see it displayed in words. Later, you may see some words that represent the response to your order.

The radar screen is updated periodically, to give you the most current view of your situation.

The following screens will provide you complete details for performing this task.

The Radar Display

This is the radar display. The grey area is land, the white area within the circle is ocean.

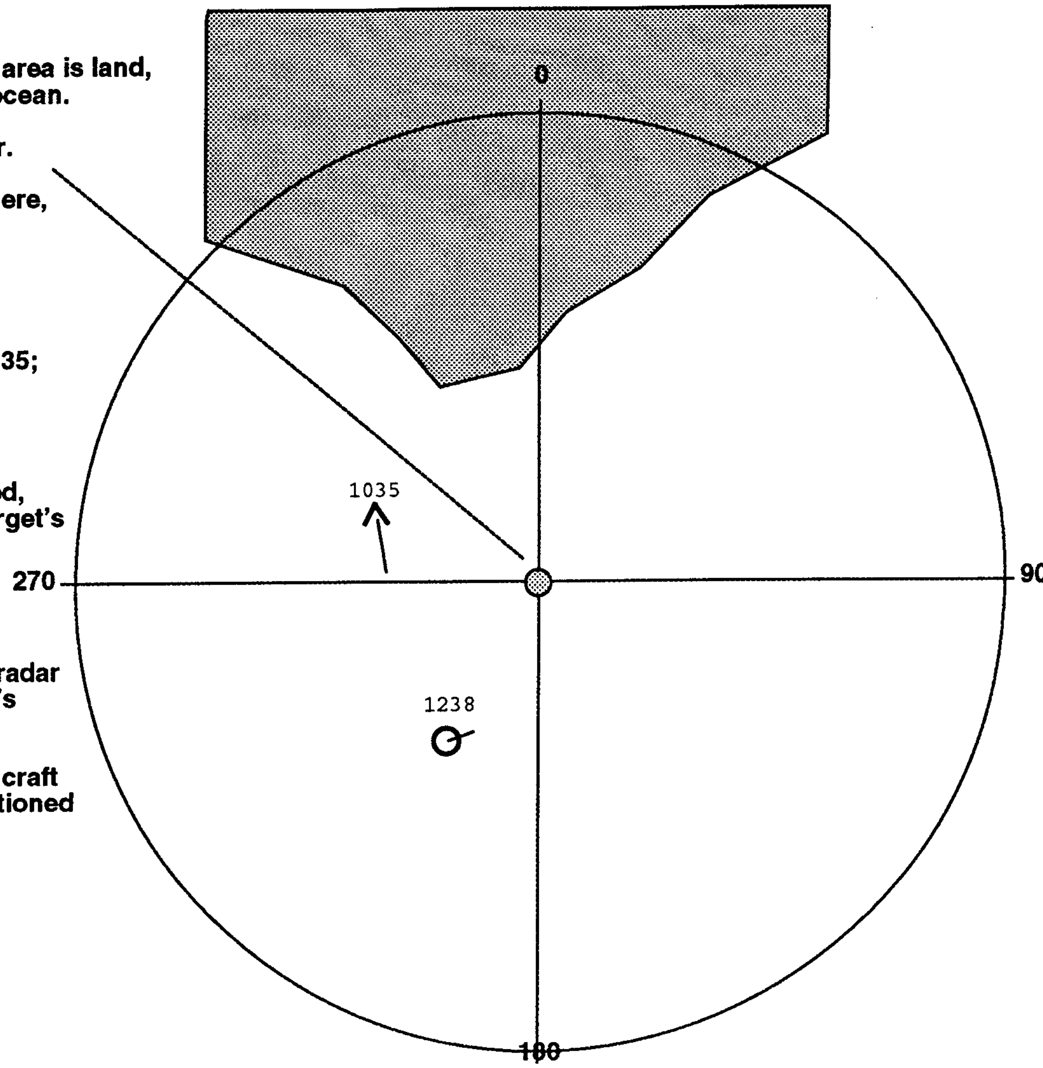
Your ship is the circle at the center.

There are two 'targets' displayed here, a ship and an aircraft.

Every target carries a 4-digit 'track' number that uniquely identifies it. The aircraft is track 1035; the ship is track 1238.

The straight line on each target is called a 'velocity leader'. Its length reflects the target's speed, and its orientation indicates the target's heading. Aircraft 1035 is heading almost due south.

The four blue numbers around the radar circle are used to determine a craft's heading and bearing. Aircraft 1035 is heading 175. The bearing is the angle between a craft and your ship. Aircraft 1035 is positioned at a bearing of 300 degrees.



Target Symbols

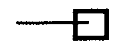
The symbol used to depict a target on the radar screen indicates whether it is an aircraft, a surface vessel, or a submarine. The symbol also indicates whether the craft has been judged to be friendly, hostle, or unknown.

The table below shows the nine possible symbols.

	Threat Assessment		
	Unknown	Friendly	Hostile
AIRCRAFT			
SHIP (surface vessel)			
SUBMARINE (sub surface)			

Here is a complete target symbol.

1039



It is a ship of unknown intentions, heading due west and assigned a track number of 1039.

Clutter 

There is a fourth kind of target, called 'clutter'. A clutter target may be real, such as an oil drilling platform, or it may just be an invalid blip caused by atmospheric conditions. In all cases, clutter targets do not move, and they show up as friendly aircraft, with zero speed and zero altitude. There are ways to clear clutter targets from the screen if they are distracting.

Controlling the Radar Display

Display		Range	
Commercial air routes	☒	256	○
Commercial air schedule	☒	128	○
Velocity leaders	☒	64	○
Missile ship circle	☒	32	●
Track numbers	☒	16	○

You control the Range of the radar display by clicking on any of the five Range 'buttons' labeled 256, 128, 64, 32, 16.

The Range establishes the distance represented by the radius of the radar circle.

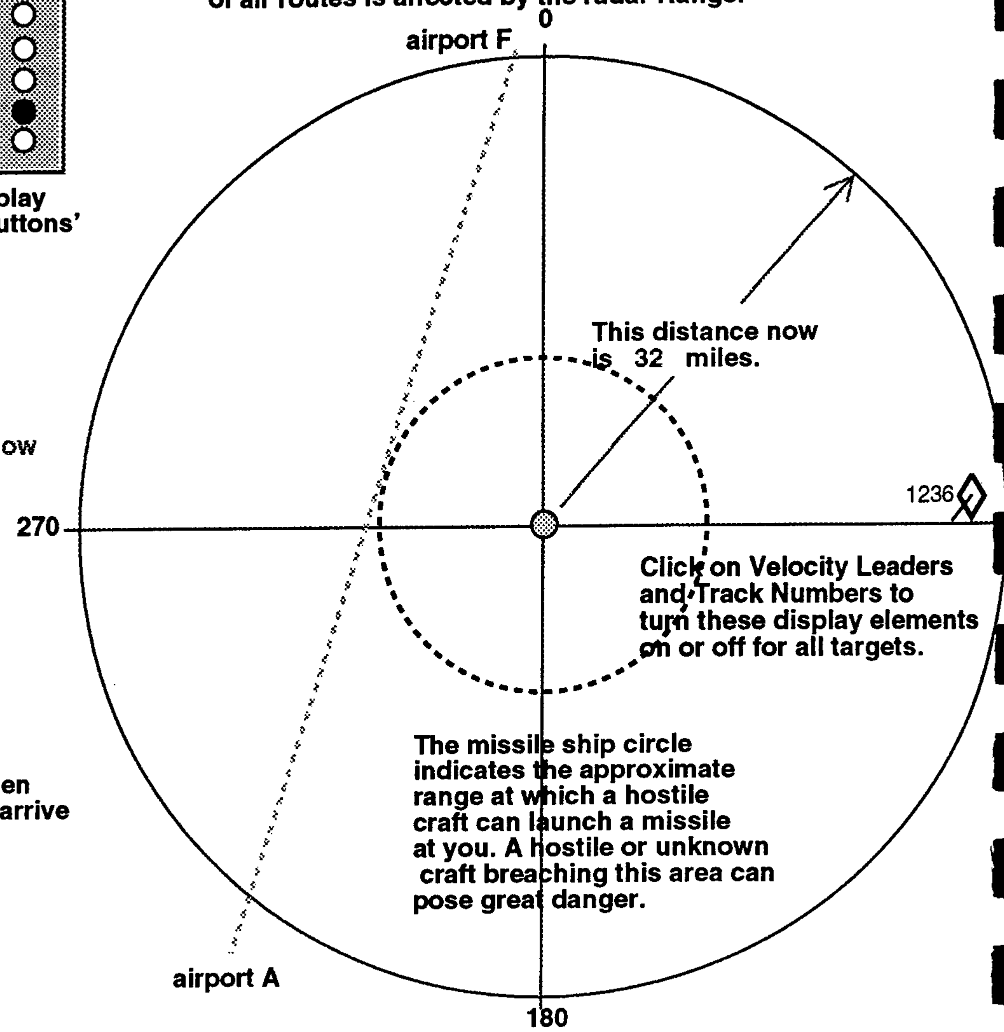
Click on different Ranges now to see how the display changes. Note that the one target, track 1236, does not appear if the radar Range is set to 16, since the target's range is 30 miles.

Then, click on each of the five boxes under Display to learn about these display elements.

Commercial air schedules indicate when air liners are scheduled to depart and arrive at various airports.

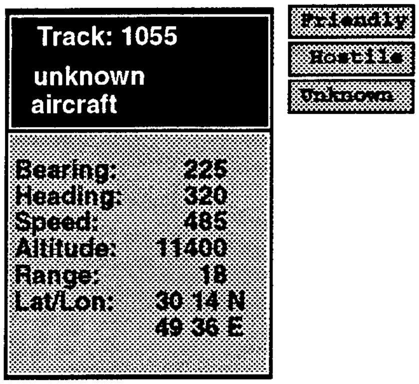
Departures from airport F		
FLT #	TO	TIME
WD 408	airport A	1145
WD 117	airport A	1330
WD 005	airport A	2100

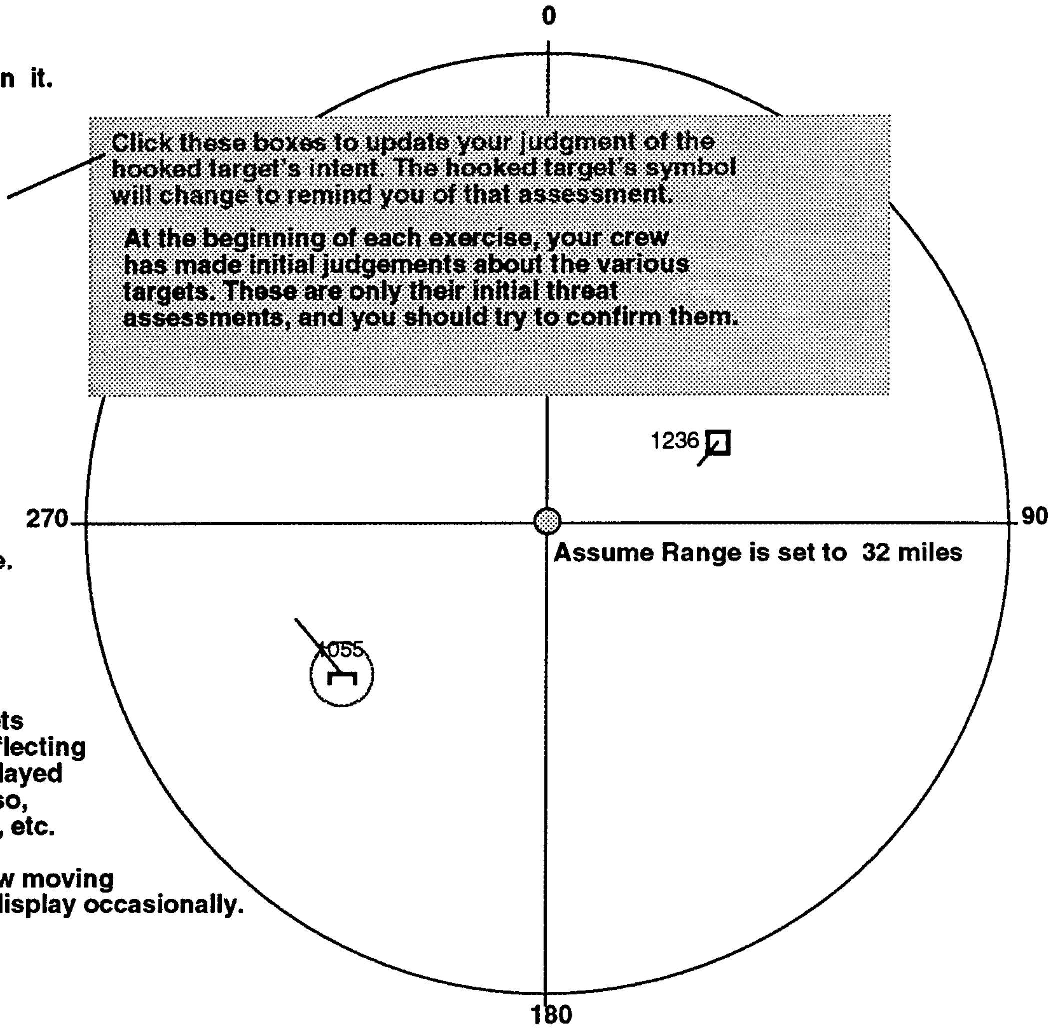
Commercial air routes are indicated on the radar as dotted orange lines. The lines represent routes that scheduled airlines in your area fly. Note that the display of air routes is affected by the radar Range.



Hooking Targets

To learn more about a target, click on it.
This is called 'hooking' the target.





Click on the two targets shown here. Notice that a beep sounds, a red circle surrounds the hooked target, and information about the target appears in the box.

During real exercises, moving targets will move every 5 to 10 seconds, reflecting their latest positions. The data displayed for the hooked target will update also, reflecting its current altitude, range, etc.

Clutter targets never move, and slow moving ships only change position on the display occasionally.

Warning Targets

Near the radar circle is a Warning box, with which you can warn the currently hooked target.

There are three levels of warnings:
Level 1 is a polite request for the hooked target to identify itself, and to state its intentions.

Level 2 asks the target to identify itself, AND to change course to avoid any conflict with your ship.

Level 3 tells the target that you may fire upon him if he does not clear the area.

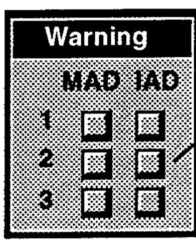
There are two communication channels on which to issue a warning:
The MAD channel is Military Air Defense, which military ships and aircraft usually monitor.
The IAD channel is International Air Defense, which most commercial airliners and ships monitor.

You can issue a warning on one channel, or both channels (one at a time).

Keep in mind that the target may not be listening to the channel you use to send your warning, or a radio malfunction might prevent transmission or reception of the warning, or his radio'd response.

Also note that the target may be deceptive about his identity and/or intentions.

Now click on the various warning buttons to see the warning being issued (targets don't respond in this example).



For example, a click here sends a Level 2 warning on the International Air Defense Channel.

180

If the target responds, his response would appear here after about 30 seconds.

```
Unidentified aircraft on a course of 283 degrees, speed 240 knots, altitud
7500 feet, position 29 degrees, 20 minutes N; 50 degrees, 15 minutes E.
This is U.S. Navy warship.
Your intentions are not clear; request you identify yourself and
immediately alter course to remain clear of my position, over.
```

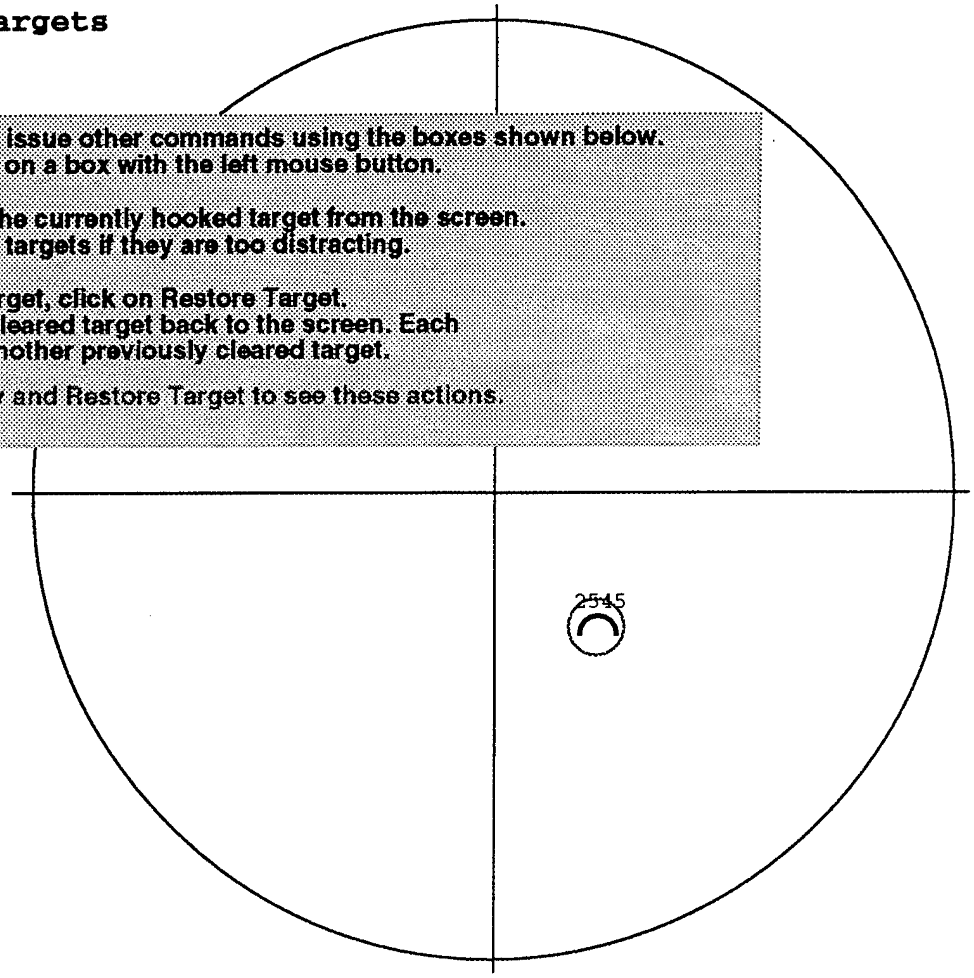
Clearing and Restoring Targets

In adddition to Warnings, you can issue other commands using the boxes shown below.
You issue a command by clicking on a box with the left mouse button.

Clear Target Display will remove the currently hooked target from the screen.
Use this command to clear clutter targets if they are too distracting.

To restore a previously cleared target, click on Restore Target.
This will bring the most recently cleared target back to the screen. Each
click on this button brings back another previously cleared target.

Now click on Clear Target Display and Restore Target to see these actions.



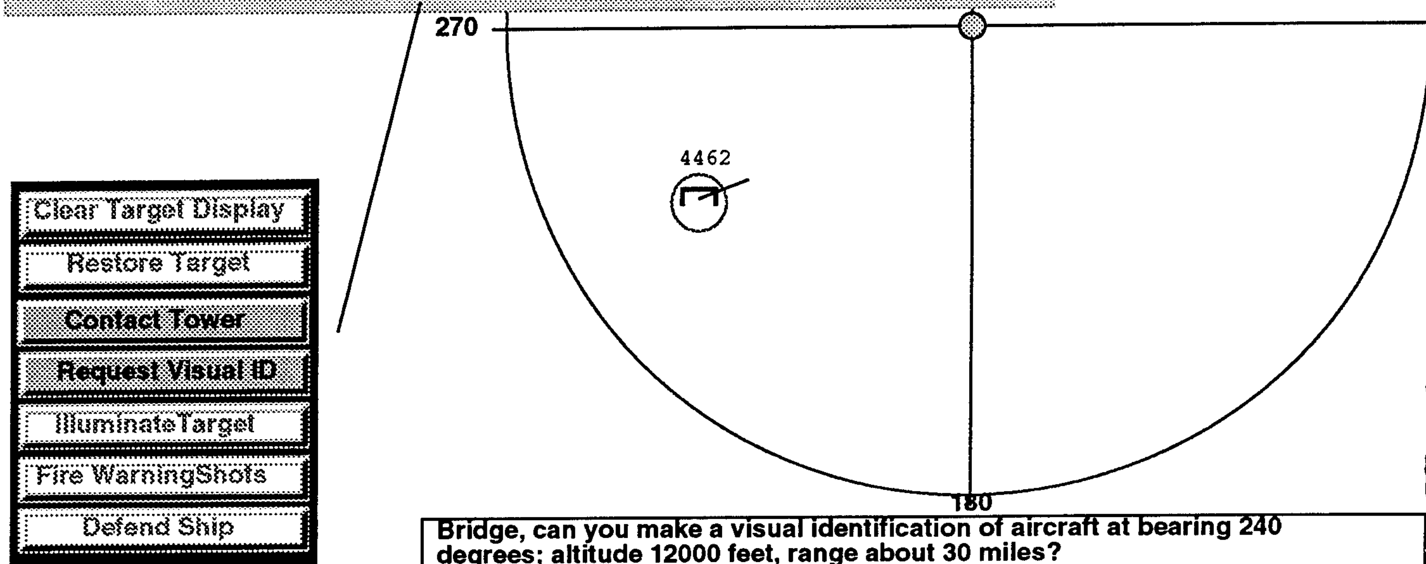
Identifying Targets

While a target might identify himself in response to a warning, two other commands give more reliable information, if conditions allow.

Contact Tower sends a radio message to an airport control tower, asking if there is a commercial airliner in the vicinity of the hooked target. The tower will advise you if there is such an airliner in that location, after about a half minute (if it receives your message).

Request Visual ID directs your crew to use high powered sighting instruments to identify the hooked target. If there is sufficient daylight, the weather conditions allow, and the hooked target is within 50 miles range, your crew will return an identification after about 10 seconds.

Now click on Contact Tower and Request Visual ID to see these actions.



Bridge, can you make a visual identification of aircraft at bearing 240 degrees; altitude 12000 feet, range about 30 miles?

(a response will appear here after some delay)

Acting on Targets

Three commands affect the hooked target directly.

Illuminate Target commands your crew to lock your fire–control radar onto the hooked target, which is a preparatory step to actually firing on it. If the target is a military craft (IFF mode is 1, 2, or 4), it will know that you are preparing to fire at it.
It may or may not turn away in response.

Fire Warning Shots commands your crew to fire near, but not at, the hooked target.
This will alert any approaching aircraft or ship that you will fire at it if it does not turn away.

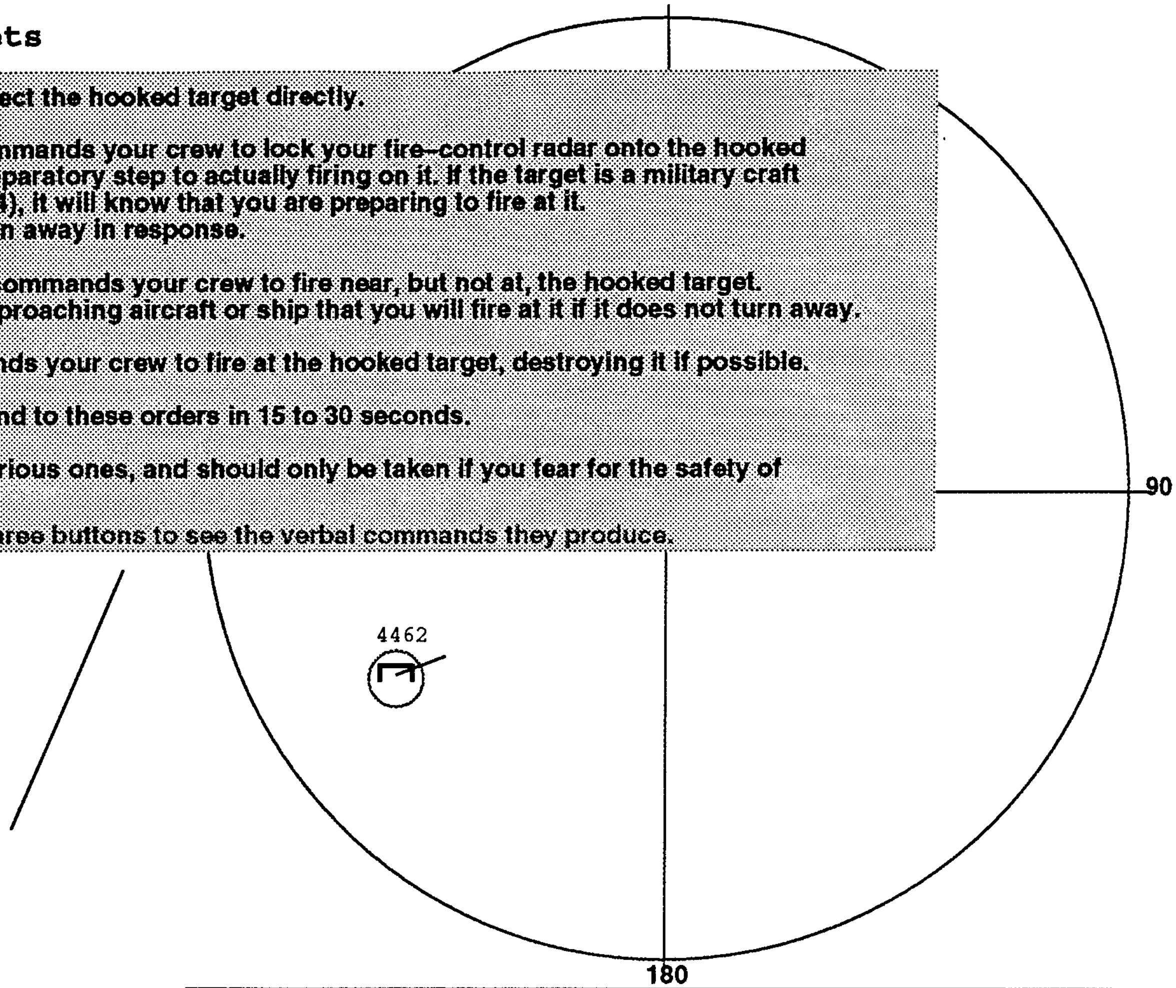
Defend Ship commands your crew to fire at the hooked target, destroying it if possible.

Your crew will respond to these orders in 15 to 30 seconds.

These actions are serious ones, and should only be taken if you fear for the safety of your ship.

Now click on these three buttons to see the verbal commands they produce.

- Clear Target Display
- Restore Target
- Contact Tower
- Request Visual ID
- IlluminateTarget
- Fire WarningShots
- Defend Ship



Fire on aircraft at bearing 240 degrees; altitude 12000 feet.

(A confirmation from your crew will appear here after some delay.)

Begin, Pause, Help, and Replay

Begin Pause Help

Begin
To initiate an exercise, click on the Begin button. After about 10 seconds, you will see the elapsed time increasing (every 5 to 10 seconds). Exercises end automatically when the exercise time limit is reached or other conditions are met. When the exercise ends, you will hear a beep, and you will see a message that the exercise is over.

Following an exercise, you may be given the opportunity to learn the true identities and conditions of the various targets, and the condition of your ship's communication equipment. If so, just click on any targets of interest or your ship. When you are ready to proceed with the next exercise, click on Begin again.

Pause
If there is a Pause button shown, you have the option to pause exercises at any time. This stops time so that you can do other things before resumming. To resume, click on the same button, now labeled Resume.

Help
If the Help button appears, you can click on it to come to the instructions Topic List, and from there to any of these instructional screens. To return to the exercise, click on Return to Topic List, at the bottom of each help screen, then click on Return to Exercises.

Replay
If you have the option to replay exercises, press the 'r' key after an exercise has terminated. You will observe a Replay box on the screen. Click on Begin, and watch the problem replayed.

Elapsed Time

9

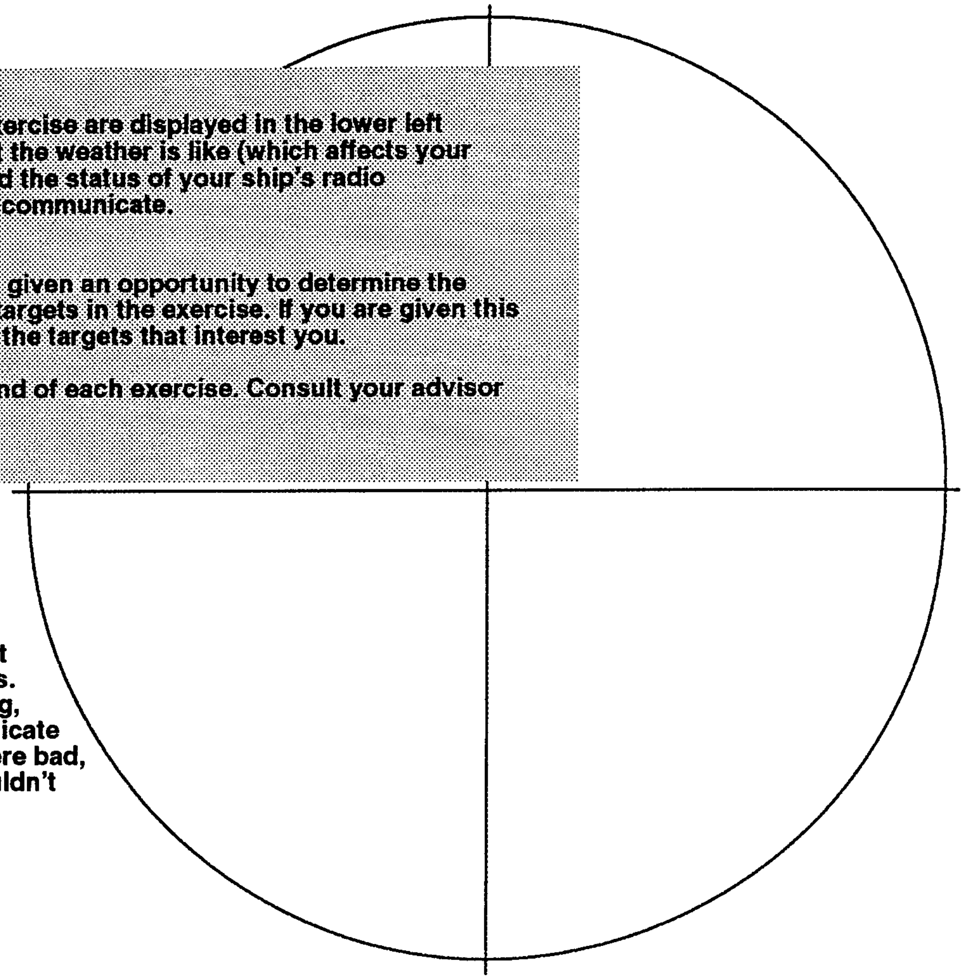
Return to Topic List

Exercise Conditions and Results

Exercise Conditions
The conditions that exist during each exercise are displayed in the lower left corner of the screen. This tells you what the weather is like (which affects your ability to make visual identifications) and the status of your ship's radio equipment, which affects your ability to communicate.

Results
At the end of each exercise, you may be given an opportunity to determine the true identify and intention of any of the targets in the exercise. If you are given this option, you will be prompted to click on the targets that interest you.

You might also observe a score at the end of each exercise. Consult your advisor for the interpretation of this number.



For this exercise, your crew can see aircraft below 25,000 feet, if they are within 20 miles. Also your ship's radio equipment is working, so you can transmit warnings and communicate with land–based towers. If your receiver were bad, you could still issue warnings, but you wouldn't receive any radio responses.

Conditions:	
Ceiling:	25000 feet
Visibility:	20 miles
Ship's transmitter	operational
Ship's receiver	operational

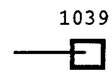
Target Symbols

The symbol used to depict a target on the radar screen indicates whether it is an aircraft, a surface vessel, or a submarine. The symbol also indicates whether the craft has been judged to be friendly, hostile, or unknown.

The table below shows the nine possible symbols.

	Threat Assessment		
	Unknown	Friendly	Hostile
AIRCRAFT			
SHIP (surface vessel)			
SUBMARINE (sub surface)			

Here is a complete target symbol.



It is a ship of unknown intentions, heading due east and assigned a track number of 1039.

Clutter 

There is a fourth kind of target, called 'clutter'. A clutter target may be real, such as an oil drilling platform, or it may just be an invalid blip caused by atmospheric conditions. In all cases, clutter targets do not move, and they show up as friendly aircraft, with zero speed and zero altitude. There are ways to clear clutter targets from the screen if they are distracting.

Appendix F

CIC Web Site

The following pages are screen prints of the CIC Web site:
http://www.fcs.net/dtowne/default.htm

Tactical Decision Making Simulation and Research

... a simulation environment which facilitates experimentation in human and machine learning of complex real-time tasks

Please be patient ... this is a graphic-intensive presentation.

Main Topics

Overview

The Tactical Decision Making simulation system, or CIC for short, executes a real-time, interactive simulation of an AEGIS-like radar system on board a military ship. The task concerns maintaining the safety of one's own ship by monitoring, communicating with, and acting upon various air and sea craft in the area. The tactical decision maker executes commands via mouse actions. These commands are then shown textually in a 'communication' area of the screen. Verbal responses to the decision maker's commands are also shown in this area - these may be confirmations from other crew members or answers from aircraft and ships that have been contacted by the decision maker.

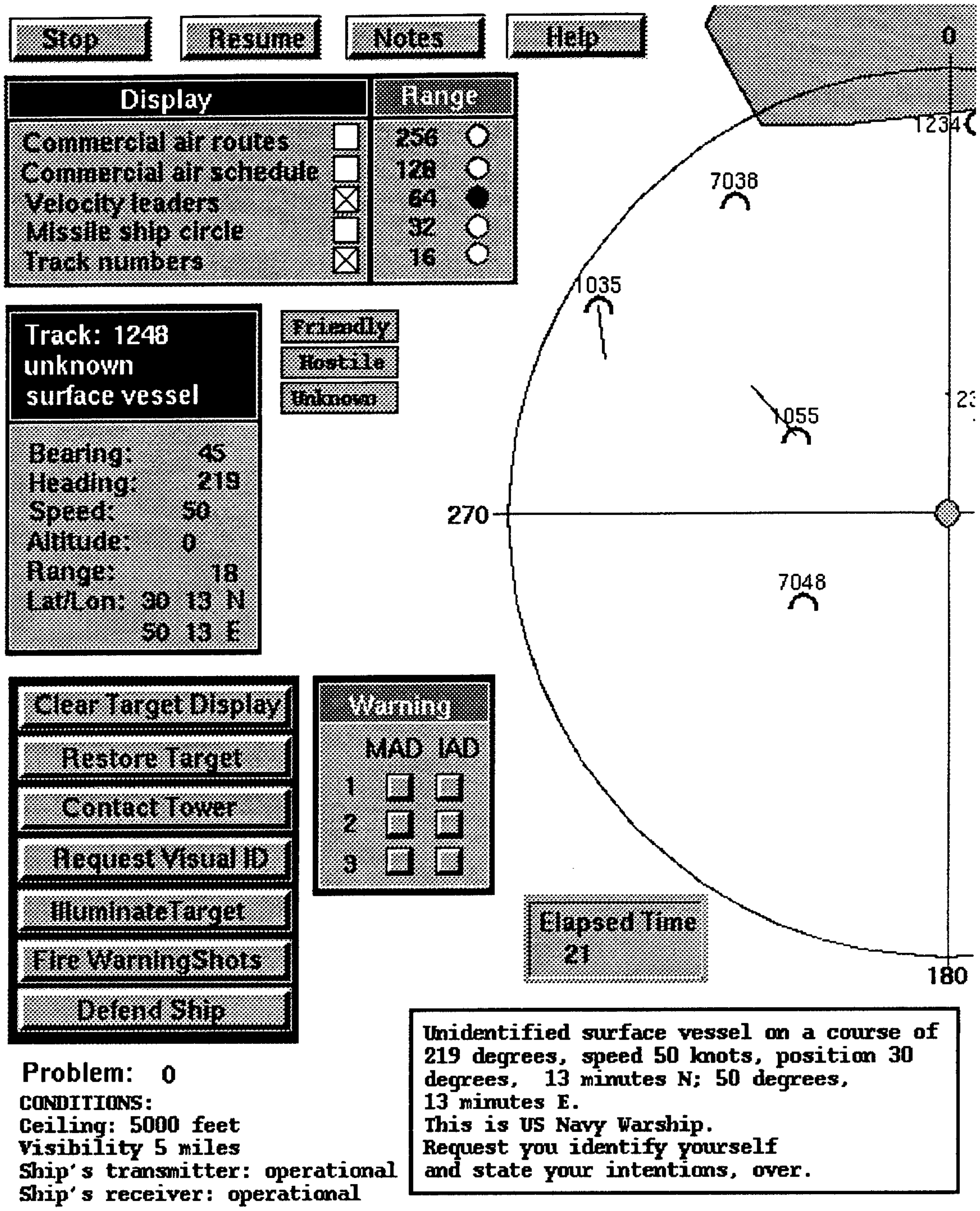
During the conduct of an exercise the various ships and aircraft move about, some in cooperative response to the commands issued by the decision maker, others perhaps in more hostile postures. Depending upon the intentions of the craft involved in a particular exercise, some aircraft or ships may attack the ship.

In summary, the CIC system is:

1. an authoring system for rapidly producing real-time tactical exercises;
2. a simulation of a shipboard radar that is tracking surrounding aircraft and ships;
3. a simulation of individual air and sea craft having intentions unknown to the operator; and
4. a research tool capable of generating exercises and recording detailed performance data.

The Task Environment

The simulation consists of a radar display depicting nearby land masses, aircraft, ships, and radar clutter. The radar display presents an 'overhead' view of the area, allowing the operator to assess the range and bearing of each track. In addition the heading and approximate speed of a track is displayed via a 'velocity leader' (line).



The display is updated approximately every 10 seconds, to reflect the current position, bearing, and heading of all the surrounding aircraft and ships. By selecting a displayed craft (track) with the mouse, the operator may obtain more precise information about that track, including:

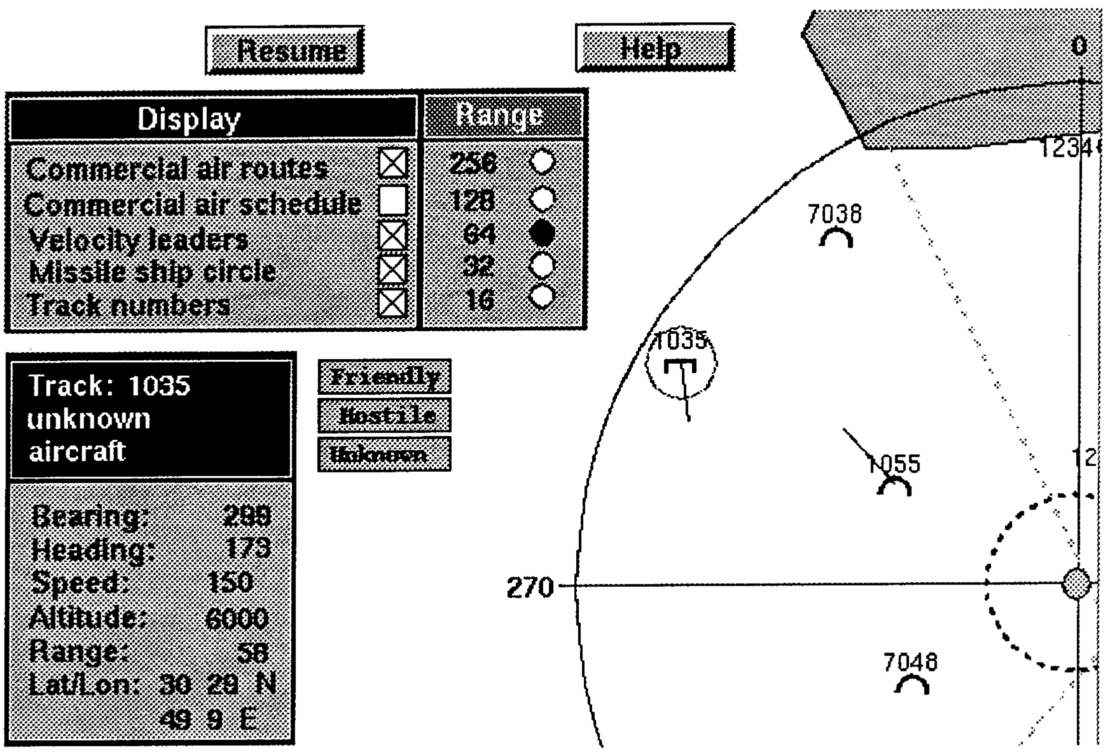
- range, bearing altitude (if air), and speed;
- current threat assessment (friendly, hostile, unknown); and
- latitude and longitude.

The Operator's Decisions and Actions

The operator's objectives are to 1) ensure that no hostile craft poses a threat to the ship, and 2) ward away friendly craft so that they are not endangered and do not present distractions or concern. More specific rules of engagement can be issued to the operator, externally.

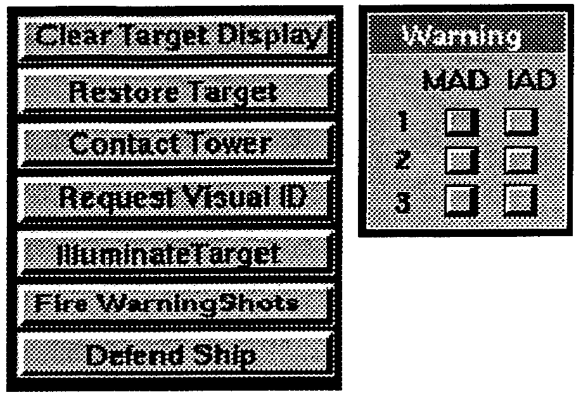
To assess the tactical situation, the operator can control:

- the range of the radar display;
- the detail of displayed tracks, including velocity leaders and track numbers;
- the display of commercial airline flight paths and schedules;
- display of simulated radar clutter; and
- the assigned threat class (friendly, hostile, or unknown) of any displayed track.

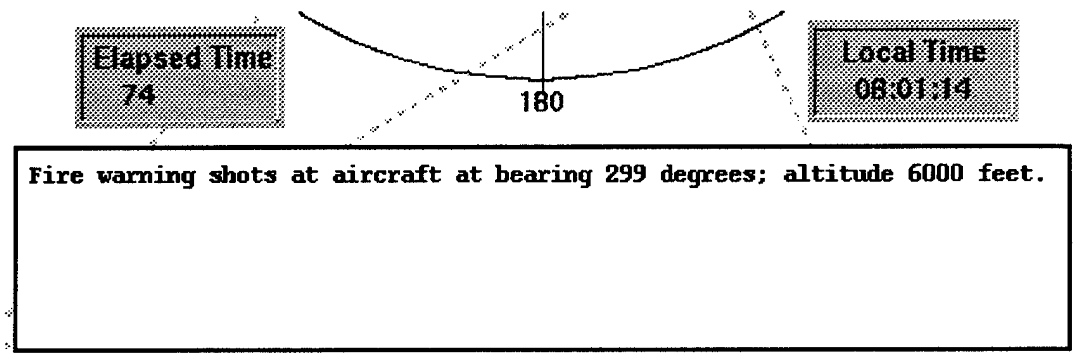


Based upon the tactical status at any time, the operator may command the crew to take action concerning a designated track. The operator may issue any of the following commands:

- attempt a visual identification of the designated track;
- radio a warning to the designated track (three levels of warning severity are available);
- contact a land-based air control facility for information about the track;
- fire warning shots at the craft;
- illuminate the craft with fire-control radar;
- defend the ship by firing upon the threatening craft.



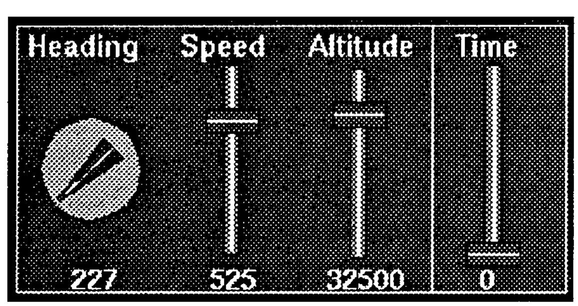
As commands are issued, they appear in the communication box shown here. Verbal responses from other aircraft and ship display here as well.



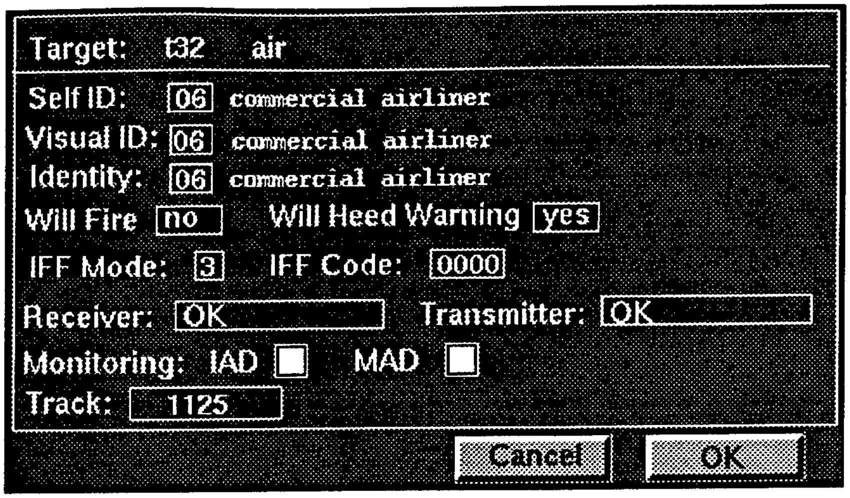
The Scenario Authoring Features

Tactical scenarios are authored by 'direct manipulation' rather than via computer programming or scripting. To author a new scenario, the experimenter:

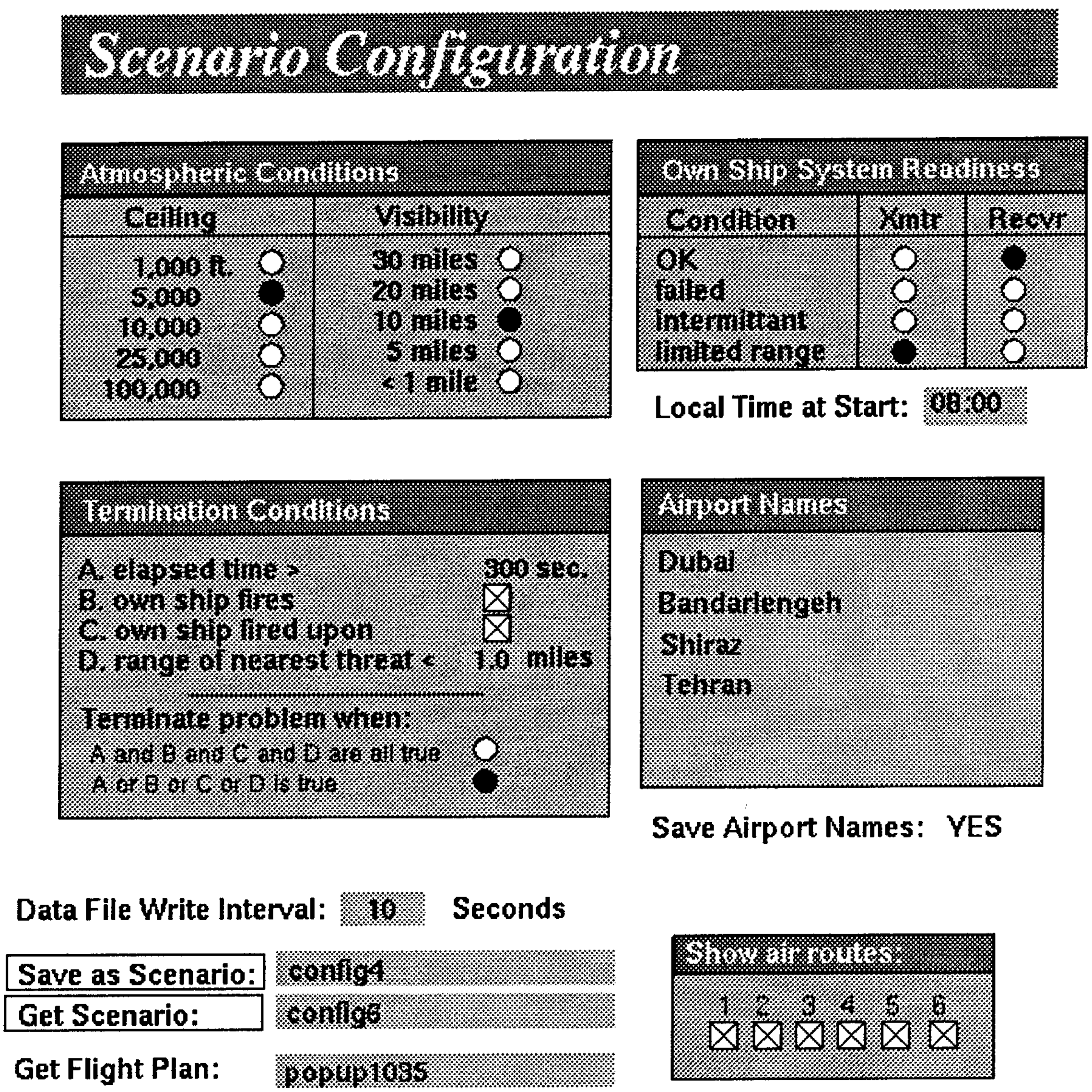
1. drags aircraft, ship, and clutter symbols onto the radar display, to indicate their initial positions;
2. sets initial headings, speeds, and altitudes (if air) of the various craft, with these controls:



3. assigns to each craft its true identity, intentions (friendly or hostile), and radio capabilities;



4. sets the weather conditions, operability of ship's communications systems, time of day of the exercise, exercise termination conditions, and airport names;



During an exercise, those craft that are friendly and do receive warnings from the operator will change course when directed. Similarly hostile aircraft and ships will mount an attack if they can achieve the necessary position. In addition to these actions, various ships and aircraft can be given 'scheduled' maneuvers that they will perform no matter what the operator commands. To do this, the experimenter maneuvers any of the ships or aircraft as if he or she were its pilot or captain. During presentation of that exercise, those maneuvers are duplicated by that craft, giving it an individual, independent, and possibly unpredictable character.

Research Features

A number of features have been provided in the CIC Simulation system specifically to address research objectives. These include:

- automatic generation of exercises (either systemmatic or random variations of conditions)
- automatic recording of the operator's decisions, and consequences thereof, throughout the scenario
- automatic computation of the proficiency exhibited by the operator, on each exercise
- capability to substitute a computer model for the human operator, to conduct research in machine learning

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Instructional Capabilities

While the CIC Tactical Decision Making system was not developed specifically to serve an instructional role, it supports a number of relatively powerful instructional functions, including:

- a replay capability that allows a learner or instructor to play back any previously completed exercise for analysis;
- a pause/resume function that allows scenarios to be paused during discussion of the tactical issues;
- a time 'warp' control that allows scenarios to be slowed or accelerated at any time; this allows learners to pass by uninteresting phases of a replayed scenario and to concentrate on the most instructive phases.
- a 'front end' orientation phase which instructs the novice in performing the task. While this is intended only to achieve marginally proficient performance in new research participants, it can be extended to address more intensive proficiency issues

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Download the Files

These files and associated documentation are available for use by ONR research contractors.

The RIDES run-time simulation engine (sRIDES)

NetScape users: right-click on the following files,
then select Save This Link as .... The CIC Simulation files...

- **CIC Version 2.7. Only available to Hybrid Learning Program contractors.**
  `[361 KB; uncompress, rename CIC if you like]`

- defaults [7 KB; rename rides_defaults]
- testml [25 KB; only used in machine learning research]

Sample ASCII files that you can tailor...(all are small)

- A sample session plan [rename SessionPlan]
- Sample aircraft and ship descriptions [rename CICDescriptions]
- Sample airport names [rename portNames]
- Sample configuration 1 ... good for building large exercises
- Sample configuration 2 ... good for building moderate exercises
- Sample configuration 3 ... good for building small exercises
- Sample configuration 4 ... a commercial airliner approaches
- Sample configuration 5 ... a hostile aircraft approaches

The User Manual

- User Manual for Word, April 1997

Development of the Simulation System

The simulation system was developed under ONR funding to support the Hybrid Learning Project, (password required) a research program concerned with both human and machine learning of complex tasks. That project was initiated by Dr. Susan Chipman and is now managed by Dr. Helen Gigley.

The simulation was developed by Dr. Douglas Towne, at Behavioral Technology Laboratories, , University of Southern California.
The underlying simulation engine is a portion of the RIDES simulation authoring system developed at USC, Allen Munro and Douglas Towne, Principal Investigators.
RIDES was developed under Air Force funding, Jim Fleming, Armstrong Laboratories, Scientific Officer.

Back to Main Topics

Last modified April 15, 1997.